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THE ROLE, IMPLEMENTATION AND IMPACT OF DIGITAL OPEN BADGES ON A CIVIL ENGINEERING DEGREE

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Abstract

The Civil Engineering degree at the Galway-Mayo Institute of Technology (GMIT) has experienced lower than average first-year retention. Management at the GMIT has highlighted the role of teaching staff in increasing retention.

This study evaluates an intervention intended to increase student engagement and motivation (two factors affecting retention) on the Computer Aided Design (CAD) module. This involved mapping the skills and behaviours required to succeed in the module to a set of digital open badges. Such badges have been shown to influence student engagement and motivation in other settings.

This case study involved an interpretive enquiry using mixed-methods (surveys, learning journals and semi-structured interviews) over two phases. Phase 1 evaluated the perceptions towards digital open badges from key stakeholders: students, lecturers, institute management and an employer. This informed the design of the digital open badge scheme, the implementation and impact of which became the focus of Phase 2.

The findings suggest that stakeholders are positive towards digital open badges. The type of motivation did not change; students showed a high tendency towards intrinsic motivation throughout. However, the level of motivation due to interest/enjoyment significantly increased. Students value digital open badges for confidence-building, peer-learning, incentivising attendance and creating links to employability. The employer values digital open badges for identifying candidates with desirable traits and preparedness for continual professional development. Institute management values digital open badges for encouraging peer-learning and attendance at classes.

The implication of the findings is that digital open badges influence student engagement and motivation through building confidence and incentivising attendance. Stakeholders have recognised positive aspects, and there is an indication that digital open badges can play an important role in enhancing student employability. A case is made for using digital open badges in other modules on the programme and more broadly within the department and other institutes.

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Acronyms

AGT	Achievement Goal Theory
BERA	British Education Research Association
CAD	Computer Aided Design
CAO	Central Admissions Office
GDPR	General Data Protection Regulation
GMIT	Galway-Mayo Institute of Technology
HREC	Human Research Ethics Committee
IMI	Intrinsic Motivation Index
OBF	Open Badge Factory
OBP	Open Badge Passport
SDT	Self-Determination Theory

Chapter 1 Introduction

1.1 Context for the study

In Ireland, construction-related degree courses have the highest rate of non-progression compared to other disciplines. In the most recent report by the Irish Higher Education Authority, the rate of non-progression for first year students in this discipline is 23% compared to a cross-discipline average of 14% in 2015/16 (Liston et al., 2018). In that report, it is claimed that if a student progresses to second year, they are more likely to complete their programme. Therefore, there is a clear benefit to retaining first year students. This echoes the 'National Strategy for Higher Education to 2030' report, where an emphasis is placed on the importance of enhancing the learning experience and engagement of first year students (Department of Education and Skills, 2011). Part of this enhancement includes early intervention at post-entry stage for students at risk of non-progression (Liston et al., 2018). The form that such interventions take is at the discretion of individual institutes. Tinto (1993) argues that institutions have a role to play in student motivation, and according to Assiter and Gibbs (2007) student motivation levels can impact retention. This sets the scene for this study. This thesis reports on the investigation into an intervention intended to play a role in motivating first year students to engage with learning. The intervention used is digital open badges, which have been shown to have motivational effects in other settings (Bin Rashid, 2017; Fanfarelli and McDaniel, 2017; Jovanovic and Devedzic, 2014) but which have not been tested in the context presented in this thesis (i.e. integrated into an undergraduate degree module in higher education in Ireland).

Demand for construction-related degree programmes in Ireland dropped during the most recent economic recession (starting in 2008). Student enrolments in this sector have begun to rise slowly in recent years but have remained lower than pre-2008 levels. There are several specific disciplines within this sector, and the focus in this thesis is on that of Civil Engineering. In total (combining Institutes of Technology and Universities) there are 16 higher education establishments offering a degree course in Civil Engineering in Ireland at present. The syllabus varies between institutes, but the accrediting professional body (Engineers

Ireland) has set criteria which all Civil Engineering programmes must meet if they are to gain professional recognition (Engineers Ireland, 2014). These criteria include knowledge and understanding of mathematics, problem solving, design of systems, conducting investigations, understanding the need for high ethical standards, ability to work in a team and under own initiative, and the ability to effectively communicate on engineering activities to other engineers and society.

The Galway-Mayo Institute of Technology (GMIT) offers a four-year full-time Bachelor of Engineering (Honours) degree in Civil Engineering. Student enrolments on this degree programme have begun to rise in recent years, after a drop-off during the economic recession in Ireland. First-year student retention on this course is relatively low. For example, in September 2015 there were 58 first year students registered, of which only 24 subsequently progressed to Year 2 (41% progression rate, the most up to date available when commencing this study). Although Liston et al. (2018) report that progression for this discipline was 77% in 2015/16, their number is an overall across all higher education institutes (i.e. Institutes of Technology and Universities). One of the factors affecting progression according to Liston et al. (2018) is the number of points achieved by students in their Leaving Certificate (CAO points). Typically, students enter the Institutes of Technology with lower CAO points compared to the University sector, and so progression rates in each sector differ. Typical progression rates in the Institute of Technology sector in Ireland are 70-71% (O'Brien, 2016), and so the 41% retention on Civil Engineering in the Galway-Mayo Institute of Technology in 2015/16 is well below expectation. The Governing Body of the Galway-Mayo Institute of Technology recognises the need to improve student retention and has set a first-year target of 71% retention (GMIT, 2015). There is, then, a need for action on the Civil Engineering programme in order to meet this target.

There are many reasons why a student might not progress. These include lack of academic preparedness for higher education, gender, nationality and age (Liston et al., 2018). Non-progression can take the form of failing at exam stage or early withdrawal from the course. Some of the reasons for withdrawal are beyond the control of lecturing staff and institute management (e.g. financial issues, family

circumstances, poor course choice), but engaging and motivating students to stay on the course is something that can be influenced by the actions of teaching staff.

The main aim of this study is to investigate the influence on student motivation of incorporating a digital open badge scheme on the Civil Engineering programme. This investigation has been done by designing the digital open badge scheme in conjunction with a range of stakeholders, implementing that scheme through one academic year, and evaluating the impact of the scheme on learner experience.

The three central Research Questions to this thesis are:

RQ 1. What role do key stakeholders - students, staff, management and employers - see for digital open badges in teaching and learning within the higher education sector?

RQ 2. What processes and practices enable participatory digital open badge use by students and teachers?

RQ 3. How do digital open badges impact on learning, learner motivation and engagement and institutional teaching processes?

The first research question seeks to understand how key stakeholders view digital open badges, and the roles that they can play in higher education. This is important, as it allows the stakeholders to express their attitudes to digital open badges in a way which sets the tone for the thesis. Through early engagement with the stakeholders, the objectives were to firstly identify the types, roles and values of digital open badges which are desirable to those stakeholders, and secondly to establish the presence of digital open badges within the Civil Engineering programme. This question is relevant to the thesis because digital open badges are relatively new and are untested in the context of this study, and so this question aims to establish the types of digital open badges to be trialled. Addressing the first research question is important because it results in making the ‘Starter Pack’ of digital open badges which are then investigated by the remaining research questions.

The second research question seeks to understand the mechanisms which enable the use of digital open badges in practice. This is important so that the process of rolling out the scheme can be given consideration and reflected upon. The design

and various mechanisms for earning and awarding the digital open badges is considered by this research question. Digital open badges have not previously been integrated into a module at the GMIT, and this question aims to investigate the mechanisms of designing, issuing and earning the digital open badges to ascertain how they can be applied to this context.

The third research question builds on the previous two to present a reflection on the overall effectiveness of the digital open badge scheme. In addition to gathering and analysing motivation levels, this research question seeks to understand the stakeholder views during and subsequent to the implementation of the scheme. Addressing all three research questions provides a foundation on which conclusions, recommendations and guidance can be offered.

1.2 Purpose of the study

The purpose of the study is to identify and investigate the roles, perceptions and impacts of incorporating digital open badges in a first-year undergraduate Civil Engineering degree module. The over-arching concept being investigated is whether the use of digital open badges will have a positive influence on learner engagement and motivation. ‘Engagement’ in this thesis is taken to mean two things: attendance at class and an interest in the module. The investigation is carried out using a mixed methods approach. Surveys are used to gather data relating to learner profile and the type and strength of motivation. Interviews are used to explore the roles, perceptions and impacts that various stakeholders see for digital open badges. The findings will be of interest to those in practice, the implication being that other practitioners will consider the use of digital open badges to increase student engagement and influence motivation in their context. To that end, the thesis offers a framework of how a digital open badge scheme can be designed and implemented more broadly in other modules.

1.3 Overview of the research

The overall aim of this thesis is to investigate the role, design, implementation and impact of a digital open badge scheme on a Civil Engineering degree. The study consists of four distinct stages. Firstly, a literature review was undertaken to identify gaps in current knowledge and uncertainties around the use of digital

open badges in higher education. As a result of this stage, the three research questions were developed. The second stage was an initial study, termed ‘Phase 1’ study, aimed at addressing the first research question, which relates to the perceptions of various stakeholders towards digital open badges. This Phase was conducted using a mixed methods approach, where student participants took part in a survey, kept a reflective learning journal, and participated in interviews. Further stakeholders (teaching staff, institute management and employer) participated in this phase through semi-structured interview. In addition to reporting on the perceptions of the stakeholders, analysis conducted on the Phase 1 data informed the design of a digital open badge scheme (referred to as the ‘Starter Pack’ of badges) to be trialled on the Computer Aided Design (CAD) module. The third stage involved the implementation of the digital open badge scheme itself, termed ‘Phase 2’ study. This stage aimed to primarily address the second and third research questions. As part of the Phase 2 study, a set digital open badges was trialled with first year students on the CAD module during the 2017-18 academic year. Using pre-delivery and post-delivery surveys, the level and quality of learner motivation were ascertained using a combination of the Intrinsic Motivation Index and Achievement Goal Theory. The learners’ perceptions and attitudes towards digital open badges were also obtained through the pre-delivery and post-delivery surveys. Following an analysis of the survey data, a set of open-ended questions was developed to address ambiguities and uncertainties discovered in the survey responses. The responses to the interview questions were analysed using thematic analysis. Further interviews with an employer and institute management took place at the end of Phase 2, with the questions developed to address issues emerging from the student interview analysis. The final stage was the drawing of conclusions and recommendations. An overview of the timeline is shown in Figure 1.1, below.

Table 1.1 Overview timeline for the research study

Stage	Start date
1. Literature Review	May 2016
2. Phase 1 Study	October 2016
3. Phase 2 Study	September 2017
4. Analysis and write-up	September 2018

1.4 Layout of the thesis

The thesis consists of the following six chapters.

Chapter 1 outlines an introduction to the study and sets the context within which the study takes place. The introduction also outlines the stages of the study and the purpose for which it was carried out.

Chapter 2 presents a review of the literature relevant to the study. This consists of literature on broader issues around student motivation and engagement, and then a focus is placed on how digital open badges have been understood and trialled in previous studies. The findings of the literature review inform the research questions of this study, where the aim is to provide clarity on what digital open badges mean to the stakeholders involved, why they can be used, how to implement them in a module, and the overall impact of using digital open badges.

Chapter 3 discusses the methodological approach taken for the study, and outlines the methods used to collect, analyse and interpret the data resulting from surveys, learning journals and interviews. This chapter also describes the philosophical approach taken, ethical considerations, and an explanation of the differences and similarities between the Phase 1 and Phase 2 studies.

Chapter 4 begins with an outline the findings from the Phase 1 study and then moves on to the Phase 2 study. The primary output from the Phase 1 study was the development of a set of digital open badges, which was designed in consideration of the literature review and the responses of various stakeholders. This set of digital open badges then became the focus for the Phase 2 study. This chapter outlines the quantitative and qualitative findings from the Phase 2 study, based on survey data and semi-structured interviews with student participants.

Chapter 5 is the discussion chapter, where interpretations are explored in consideration of the quantitative findings, qualitative findings and the literature.

Chapter 6 is the conclusions and recommendations chapter, which are presented along with an indication of areas for further investigation arising from the study and a personal reflection.

1.5 Conclusion

This chapter has presented a context for the study, an overview of the approach taken, and an explanation of the layout of the thesis. The context is that of exploring whether an intervention has an influence on learner engagement and motivation on a first year module on a Bachelor of Engineering (Honours) degree, Computer Aided Design (CAD). The implication is that increased motivation will have a positive effect on retention. The intervention in question is the use of digital open badges within the module. The approach that has been taken involves a number of stages, set out in such a way as to initially gather the perceptions of various stakeholders to digital open badges, leading to the development of a set of digital open badges, which are then implemented and evaluated with various stakeholders.

Chapter 2 Literature review

2.1 Introduction

Retention is a complex issue, according to Weller et al. (2018). There are many factors which influence retention. These include prior academic performance (Liston et al., 2018), homesickness (Fisher, 1989) and motivation (Assiter and Gibbs, 2007). Of these, institutions can only effectively influence student motivation (Tinto, 1993). The focus of the literature review is therefore primarily on the role of motivation in the context of retention.

The overall aim of this thesis is to explore the role, implementation and impact of a digital open badge scheme on a Civil Engineering degree. The setting is a CAD module on the first year of the degree, a type of module which is considered complex and difficult to learn for the first-time user (Li et al., 2012). The following literature review firstly considers learner motivation and engagement in broad terms and then focusses on perceptions, actions and impacts relating to the potential for digital open badges to act as a motivational device in the CAD module.

2.2 Learner motivation and engagement

Motivation to engage in learning is a complex issue. Lifestyle demands and rapidly changing teaching and learning environments are cited by Horstmanshof and Zimitat (2007) as factors which influence motivation to engage in higher education. With first year students, lifestyle changes are to be expected where the learner has moved away from the home environment for the first time, and in some cases, this change is made increasingly complex where the learner has to work part-time to financially support their education (Choy, 2002). The adjustment to learning in higher education compared to secondary level education represents a rapidly changing teaching and learning environment. Despite such changes caused by the transition between secondary and higher education, Daskalovska et al. (2012) argue that students with strong motivation can achieve a lot regardless of circumstances. Motivation can be viewed as either extrinsic or intrinsic in nature. Extrinsic motivation is influenced by external incentives, such as a reward (Brown, 2007), and intrinsic motivation is influenced by the learners'

ambition and aims (Ur, 1991). Both types of motivation are important for success, according to Daskalovska et al. (2012), and they argue that teachers can influence both types by offering rewards, positive feedback and by promoting self-confidence.

Learner engagement is the result of combining motivation with cognitive competence and social interaction, according to Guthrie and Davis (2003). Such engagement ‘occurs when students develop an interest in and form a bond with a topic that lasts beyond the short term’ (Moley et al., 2011, p. 251). This aligns with what Schussler describes as a deeper connection (Schussler, 2009). Deep learning is engagement with learning in a way that leads to expertise via the processing of new knowledge with previous knowledge, and reflection (Marton and Salho, 1976). In their study, Horstmanshof and Zimitat (2007) argue that evidence of deep learning is a measure of student engagement and they make a link between deep learning approaches and intrinsic motivation: students who are motivated by planning ahead (future-orientated) are more likely to engage with deep learning. They suggest that innovative ways of working with students to promote early awareness raising of aspirations and future orientation are important for improving engagement.

2.3 Roles for digital open badges in higher education

Differing perspectives and motivations mean that stakeholders can often stress different, even contradictory, aspects and affordances of digital open badges. Ahn et al. (2014) describe three roles for digital open badges: as a motivator of behaviour, as a pedagogical tool and as a signifier that might link economic and social opportunities. These three roles would seem to be a good fit for the key stakeholders that might be interested in digital open badges (students, staff, management and employers). However, others place emphasis and the value of digital open badges elsewhere. Knight and Casilli (2012) describe a shift in learning away from a traditional approach to one that is ‘...inclusive, social, informal, participatory, creative and lifelong’ (p. 279) and they argue that digital open badges can play a significant role in capturing learning that currently goes undetected in the traditional approach. A further role for digital open badges is found in Mewburn (2017), who describes such badges as a means of

communication, where the actors have to share a common meaning. The overall role as a means of communication is also seen in Gibson et al. (2016) where three roles for digital open badges are identified: to bring transparency to learning, to reveal meaningful detail about the learning to all stakeholders and to provide an open mechanism for the recognition of skills. Gibson et al. (2016) propose a further role for digital open badges that would also link the key stakeholders into a shared meaning: the potential for digital open badges to play a role in aiding the recognition of prior learning for those seeking to enter formal education through an experiential/informal education route. It is clear, then, that there are many interpretations of the roles that digital open badges can play in education. While there are commonalities, such as digital open badges being in essence a communication device, there remains no agreed-upon single set of roles.

Establishing a shared meaning for digital open badges across all stakeholders is a complex task. For example, in Ahn et al. (2014) we learn that even within one stakeholder group (students) there are multiple meanings attributed to digital open badges: some see them as a stepping-stone marking progression and some see them as an external symbol to be shared to represent themselves to others. This, when considered with similar points made by Halavais (2012), indicates a gap in understanding that should be addressed: there is a need to establish a negotiated and shared meaning amongst all stakeholders in relation to the roles of digital open badges. Given that Ahn et al. (2014) reported multiple meanings for digital open badges within just one stakeholder group, this indicates that aiming for a single shared set of definitions across a number of different stakeholder groups is problematic. However, involving all stakeholder groups at the scheme design and evaluation stages would help to avoid ambiguities and/or misunderstandings.

Most studies tend to focus on learners, with relatively few including employers. In a review of literature relating to digital open badges that was available up to December 2015, Liyanagunawardena et al. (2017) found just 64 articles. These articles covered a range of stakeholder groups, but of that number, only three articles had considered the employers perspective. The implication here is that employers have not yet been given sufficient voice in the discussion around the roles for digital open badges. From a teaching perspective, there is a motivational role associated with digital open badges (Ahn et al., 2014; Santos et al., 2013a).

By contrast, Raish and Rimland (2016) see no motivational role, but rather focus on digital open badges as a form of credential to which employers might attach meaning. Their study is limited to employers only, though, and even so they argue that achieving collective approval for an innovation like digital open badges is difficult. There have been other suggestions as to how digital open badges could be used by employers: for example, O’Byrne et al. (2015) argue that digital open badges can be linked to workplace and professional settings, where peer-awarded digital open badges can be a vehicle for community-building. O’Byrne et al. (2015) note that ‘seeking external backing or credential that is valued by outside entities’ (p.453) was the most challenging aspect of their project. Gibson et al. (2016) also raise a concern regarding credibility: they argue that employers need to trust all aspects of the digital open badge (for example transparency, evidence and branding). Credibility can be reinforced by transparency above all, according to Santos et al. (2015), particularly where peer-issuing of digital open badges takes place. Hickey (2016) argues that digital open badge credibility is derived from the accreditation of the issuing institution. There is an ‘emerging economy of credentialism’ according to Willis III et al. (2016, p. 36), where the credibility of the issuer is central to the value of a digital open badge. Perhaps involving employers in the early stages of the digital open badge scheme design process would help inform the implementation and at the same time go some way to building a relationship where credibility is achieved.

There is good reason for such involvement, to investigate a link between peer-awarded digital open badges and the social interaction which, according to Heaton-Shrestha et al. (2009), improves motivation. The role of digital open badges within the frame of community can also be seen in Diaz (2013), where it is argued that digital open badges offer potential for recognising and tracking professional development within communities of practice. Diaz (2013) stops short, however, of describing an effective way to do this. Santos et al. (2013a) argue that engagement and motivation are ‘socially created and maintained through an active process of participation, interaction, sharing and co-regulation’ (p. 351). This aligns with the community-building and inclusive approaches seen in Diaz (2013), Haaranen et al. (2014) and Laanpere et al. (2014). In their study (based on the SAPO Campus platform) Santos et al. (2013a) contend that the

student perception of digital open badges was positive, and that the badges contributed to making students ‘feel more engaged and motivated’ (p. 351), and that 77.8% of the students agreed that the badges made them feel more engaged with tutorials. One of their findings, however, contrasts those of University of California, Davis (2014) in that SAPO Campus students did not want to take on the role of creating and assigning digital open badges. However, Santos et al. (2013a) only used a short questionnaire to collect the views of a relatively small number of students (n=27) without triangulation with interviews. In a more recent article on the SAPO Campus case study, Pedro et al. (2015) report that students are now contributing to the process of awarding digital open badges, in a peer-learning environment. However, the number of digital open badges created and issued by students is relatively small (94% of badges issued in the study were created by teachers), and their report is limited in exploring exactly why that is the case. Barry (2013) provides further examples of student perceptions of digital open badges, where he claims that badges can help develop lifelong learning skills (he cites the 2012 HASTAC Digital Media and Learning competition as an example) and promote participatory learning (he offers the Peer 2 Peer University as an example of this). This demonstrates that there is considerable scope for the participatory use of digital open badges.

Designing for motivation seems to be a key element in the creation and delivery of digital open badges. Jovanovic and Devedzic (2014) describe digital open badges as a ‘novel means to motivate, scaffold and recognise learning’ (p. 115). This article serves to reinforce some themes already identified: the range of stakeholders goes beyond curriculum designers, digital open badges offer flexible recognition of learning, peer-learning plays a role and a well-developed digital open badge scheme is essential. Crosling et al. (2009) report that linking higher education with employability can have a positive effect on learner engagement. Similarly, Hassan and Bhat (2014) contend that delivering learning material that is relevant to future employment has a motivational effect on learners. The link between digital open badges and employability appears clear, then. Considering this, and the lack of employer involvement seen in the literature review by Liyanagunawardena et al. (2017), there is good reason to involve the employer as a stakeholder at the design stage. The need for guidance on digital open badges

for educators too is highlighted in Facey-Shaw et al. (2017). It would appear then, that multiple meanings and roles exist for digital open badges, and there is a requirement for communicating and sharing these meanings between stakeholders.

2.4 The design of a digital open badge scheme

This section will focus firstly on a general approach to designing a digital open badge scheme, and then review digital open badges designed around a gamification approach.

2.4.1 Stakeholder involvement in digital open badge scheme design

If digital open badges are seen as a means of motivation, the question then arises: whose role is it to generate this motivation in the first place? There are three key stakeholders who could make a contribution to generating motivation: teachers, learners and employers. Crosling et al. (2009) contend that teachers can play a role in influencing motivation, and Buckley and Doyle (2016) go further to say that one of the roles of the teacher is to manage learner motivation. However, a contrasting view can be read in Hegarty (2011) where it is argued that the responsibility for motivation rests with the learners. Santos et al. (2013b) share this view, suggesting that while motivation is the single most important factor in learning, the teachers' role is to teach, not motivate. In contrast to the student-centred approach to digital open badge scheme design seen in Haaranen et al. (2014), Reid et al. (2015) report on a case study where digital open badges were designed as an intervention by the institute with no design involvement of the students. A limitation of the Reid et al. (2015) study is that they focussed on designing digital open badges around the learning outcomes of particular modules: they do not allow for recognising skills or behaviours beyond the syllabus, or as part of community-building. Where Reid et al. (2015) is useful however, is that their findings further demonstrate the motivational effect of digital open badges, even within the setting of a limited, teacher-led approach. This echoes a link also made by Jovanovic and Devedzic (2014). When learners are given a voice in their own goal-setting, it can have a positive effect on motivation levels (Morisano et al., 2018). In this context, with respect to the role

of learners in designing digital open badges, Haaranen et al. (2014) make the point that ‘by designing badges, learners can participate in designing learning goals’ (p. 41). This aligns with the user-centric approach of Laanpere et al. (2014) and with the student involvement seen at the University of California, Davis, where students were involved in defining the criteria for the digital open badges they can then earn as part of the digital open badge design process, (UCD, 2014).

As an alternative to student-centred and teacher-led approaches, Williams et al. (2011) advocate communities of practice as a framework for education. Part of this approach is an open interaction between peers and instructors, which they say can improve self-motivation in learners. Myllymäki and Hakala (2015) identify the reporting of hidden learning as a challenge that digital open badges can address, but they do not offer any insight into how to capture the hidden learning in the first place. Perhaps applying the community of practice framework to the development of digital open badges (Williams et al., 2011) might help identify way to capture the hidden learning that eluded Myllymäki and Hakala (2015). As before, however, the employer voice is missing from the discussion. Schenke et al. (2013) offer the suggestion to link earning digital open badges with earning internships as a potential employer-lead motivator, but such a motivational effect of including the employer in the community of practice remains to be investigated.

A second key point, alongside who is driving the process of designing the digital open badge scheme, is the question around the longevity of the motivational impact, and whether that can be addressed at the scheme design stage. Devedžić and Jovanovic (2015) claim to offer a comprehensive approach to developing digital open badges. The authors present their views on the research of others into the perspectives of learners, teachers, institutions and employers regarding digital open badges. For example, in Devedžić and Jovanovic (2015) the learners value immediate feedback, and that digital open badges used for this feedback (as opposed to those awarded as reward-only) can have a positive effect on behaviour. Immediate feedback for learners is also viewed positively by Li et al. (2012). A limitation of the positive impact of immediate feedback in a short-term setting is that it could potentially be a result of the novelty factor. A longer-term study may address this issue.

In their literature review, Liyanagunawardena et al. (2017) found that the design intention for using digital open badges was primarily for positive behaviour, actions and outcomes. However, Santos et al. (2013b) report that digital open badges issued for negative reasons were ranked most valuable by students (for example, a badge awarded for not taking part in a forum discussion). This finding is interesting in that it is a rare example of a negative digital open badge, but no follow-up work has been done to find out exactly why the students ranked the negative badge as most valuable: was such a badge ever awarded/collected, or was the presence of it enough of a deterrent?

Considering these contrasting views, it would appear that designing a digital open badge scheme in order to impact motivation is not a simple process.

2.4.2 Gamification and digital open badges

Digital open badges are often used as a key mechanic in gamification.

Gamification is the use of ‘game-based mechanics, aesthetics, and game thinking to engage people, motivate action, promote learning and solve problems’ (Kapp, 2012, p.10). There is a contention (Buckley and Doyle, 2016) that gamification is a means of enacting teacher-led motivation in learners. The source of such motivation stems from the competitive nature of gaming (Nicholson, 2012). While Wiggins (2016) suggests that digital open badges are a way to enact a reward system for gamification, he also warns that such a role may only provide extrinsic motivation and Glover (2013) warns that gamification can even demotivate some learners. Gamification may be suited to learning software tasks, which are usually well structured and cumulative. Assiter and Gibbs (2007) report that students convey a preference for structured teaching and Buckley and Doyle (2016) contend that gamification works best where clear rules exist, compared to free-form learning activities such as essays. Caution is argued by Hamari et al. (2014) in that gamification success depends on the context in which it is used: suggesting that contexts which introduce competition are less positive. This aligns with Kapp (2012), who warns that non-competitive gaming should be used for lower experienced gamers: while competition can increase intrinsic motivation, it can be stressful for those unfamiliar with the environment. There remains, then, some debate on the usefulness of gamification.

In Bin Rashid (2017) the contention is that the use of gamification can increase interest, motivation and attendance levels in students (however, it is unclear whether the study is of primary, secondary or tertiary level students). A limitation of this study is that the gamification was only trialled for a two-month period, and a longer-term study may reveal more reliable results. This is interesting, however, in that it echoes the notion seen in Iosup and Epema (2014) that gamification may only have a short-term impact in any case, due to the novelty factor. They do not define what is meant by short term: is it the effect of the gamification, or the period over which it is trialled? Harmon and Copeland (2016) found that digital open badges offer a memorable token for future reference, echoing the use as a memento or souvenir identified by Cross et al. (2014). Does this suggest, then, that digital open badges may offer a means of addressing the short-term impact identified as a limitation of gamification by Iosup and Epema (2014)? Harmon and Copeland (2016) argue that digital open badges offered for achieving a high grade (A-, but they do not define that in terms of percentage) should be linked to skills important to industry.

Another way in which digital open badges can be used as a gamification device to increase learner engagement and achievement is found in Rigole et al. (2017), where the mechanism of 'level-up' badges is reported to have a positive effect on engagement. The design intent of the 'level-up' digital open badge is to offer students an incentive to make extra effort to gain skills mastery by taking on optional work. Hamari (2017) also report positively on a form of levelling-up by using unlockable bronze, silver and gold versions of digital open badges. This contrasts with an earlier study by McDaniel et al. (2012), where it was found that learners were frustrated by unlockable digital open badges. In any case, if such digital open badges can be shown to require intrinsic motivation (linked to skills mastery), they offer a counter-argument to Wiggins (2016) who contends that badges may only provide extrinsic motivation.

A second gamification mechanic used for motivation is the leader board. Santos et al. (2013b) say that leader boards had a positive effect on increasing learner motivation, but Dominguez et al. (2013) found more mixed results where some students expressed negative views on leader boards. Iosup and Epema (2014) offer a suggestion to address the issue of leader boards being demoralising for

poorer-performing students. They suggest re-ordering the leader board so that lower ranked learners are listed in the middle of the board. However, Iosup and Epema (2014) make the point that gamification in higher education is complicated due to increasing diversity amongst students: this echoes other studies that show gamification has mixed results and depends on context and players (Dominguez et al., 2013; Santos et al., 2013b). Iosup and Epema (2014) classify high achievers as those getting 80% or higher in assessments. They say that there is a need for high achievers in every class, without whom attendance and quality will drop, and that an incentive of extra labs or classes could be offered for high achievers. This raises unanswered questions, however: does it suggest that publicly rewarding high achievers will encourage others to improve, and does that mean that students with less ability miss out on extra classes that might help them to improve? Iosup and Epema (2014) used surveys to conclude high levels of student satisfaction overall regarding gamification.

2.5 Further unpacking the motivational impact of digital open badges

A potential link between digital open badges and motivation has been made by Jovanovic and Devedzic (2014), although they warn us that since the use of digital open badges ‘...is in its early stages, there are numerous open questions and concerns related to their use in these roles’ (p.119). Potential indicators of improved motivation which digital open badges might promote include improved attendance (Bin Rashid, 2017), improved final grades (Fanfarelli and McDaniel, 2017), and improved means of credentialing (Ahn et al., 2014). If we accept that there is a link between motivation and digital open badges (Jovanovic and Devedzic, 2014), then we need to consider exactly what this motivation is, and how its impact can be measured. Motivation is complex and depends on whether the learner expects to perform well or not according to Reid et al. (2015). Ahn et al. (2014) argue that as a motivator, digital open badges can increase extrinsic motivation, but at the cost of intrinsic motivation. An intrinsic/extrinsic divide in terms of motivation may indeed be an over-simplification, as Köseoğlu (2013) describes how a scale developed by Vallerand et al. (1992) uses seven subsets of motivation. These include three types of intrinsic, three types of extrinsic and a

lack of motivation. Köseoğlu (2013) contends that when a person is intrinsically motivated, no reward or punishment is required. Does this suggest it is difficult/impossible in a traditional education context (centred on grades) to motivate intrinsically? Köseoğlu (2013) finds that engineering students tend to be predominantly extrinsically motivated. If that is the case, then the contention by Wiggins (2016) that digital open badges only offer extrinsic motivation can be tolerated. A limitation of Köseoğlu (2013) is that it does not account for student profile, to see if there is a correlation with motivation and prior ability.

A theoretical approach to measuring motivation seen in many articles is the Self-Determination Theory (SDT) as developed by Deci and Ryan (1985) as part of their exploration of Achievement Goal Theory (AGT). Hegarty (2011), however, sees a distinction between SDT and AGT: he contends that AGT is suitable way to identify the type of motivation (skills mastery, etc.) while SDT is suitable for measuring the strength of motivation. McCord and Matusovich (2013) modify the Intrinsic Motivation Index (IMI) found in the SDT, to measure motivation levels in engineering students. That study involved a survey of a relatively small number of students (16 complete responses from an estimated 250 invited participants) with no open-ended questions or interviews for triangulation. The McCord and Matusovich (2013) study also included other measures for motivation, and while they concluded that some of the measures they trialled need to be reconfigured for further research, they did not find a need to alter the IMI measure. They imply that measuring motivation in this way can help understand the relationship between motivation type and conceptual understanding, so that the learning environment can be tailored to support intrinsic motivation. In McDaniel and Fanfarelli (2015) we find further evidence of the Intrinsic Motivation Index being deemed an appropriate way to measure intrinsic motivation. In this case, the authors make a justification for using the IMI to understand the role of digital open badges in the learning environment.

The Intrinsic Motivation Index (IMI) questionnaire is a data gathering tool devised by Deci and Ryan (1985), and has been primarily used to establish type and strength of motivation at one instance in time. Amarose and Horn (2001), however, adapted the IMI questionnaire so that it could be used in both a pre-activity and post-activity manner to measure differences in intrinsic motivation

over time. The context of their study was to examine motivation levels in first-year college athletes depending on their perceptions of coach behaviour. Although this context is not the same as an intervention using digital open badges, they argue that their adaption of the IMI is a reliable way to measure intrinsic motivation. This sets a precedent for such an approach to measuring motivation. As an example of where such an approach has been used with digital open badges, Reid et al. (2015) used a modified IMI questionnaire to measure intrinsic motivation over the course of one (16 week) semester. While Reid et al. (2015) make a case for the suitability of the IMI to measure motivation over time, they conclude that the digital open badges by themselves only motivate students who expect to do well in the first place and are therefore not a 'magic bullet for learning in all environments' (p. 393). In addition to the short time scale (one semester), a further limitation of the Reid et al. (2015) study is that the digital open badges in their scheme were linked with assessments only, and therefore were essentially simply an extension of the grade system: there were no digital open badges made available for non-academic activities or behaviours.

2.6 Conclusion

There are multiple stakeholders to consider when designing a digital open badge scheme (Devedžic and Jovanovic, 2015). The inclusion of each stakeholder group is seen as important in developing a digital open badge scheme if a shared meaning (or meanings) is to be found for the role of digital open badges. This is a complex negotiation, as each stakeholder has their own views, which can differ to other stakeholders. Even within single stakeholder groups, multiple roles for digital open badges have been identified Ahn et al. (2014). This remains unresolved in the literature, then, and represents an area worthy of further investigation. This thesis involves all stakeholder groups within one study, using a mixed methods approach to ascertain perceptions about the roles of digital open badges.

As with roles for digital open badges, there are multiple manners in which they can be implemented. These include digital open badges linked to assessment grades, as formative feedback, as markers of progress, and as drivers of competition. Considering the many ways that digital open badges can be enabled

and used in practice by teachers and learners, defining best practice may be a complex task. Indeed, there may not even exist one ‘best’ approach. For example, McDaniel and Fanfarelli (2015) contend that digital open badges are a suitable mechanism for providing feedback to learners. They suggest that best-practice in relation to digital open badges is that they should be linked to performance. However, Hickey (2016), contends best-practice is where digital open badges are linked to behaviour. Again, there are conflicts in the literature, as to the best way to design and implement a digital open badge scheme. This thesis aims to address this conflict by investigating the effectiveness and perceptions of several mechanisms for implementing digital open badges. For example, are there certain types of digital open badges (e.g. issued for academic performance) that are more effective and valued than others (e.g. issued for behavioural activity)? The process of exploring approaches to practice should involve all stakeholder groups: the model used in this thesis focuses on just such an inclusive approach. Stakeholder views will inform the design, the implementation and the review of the digital open badge scheme.

With respect to the impact digital open badges might have on learning, motivation and teaching practice, it is argued that digital open badges can improve learner motivation (Jovanovic and Devedzic, 2014). The transparent and detailed feedback offered by digital open badges has a positive impact on learner engagement (Devedžic and Jovanovic, 2015). In terms of how digital open badges might impact institutional teaching practices, they can act as a means of collaboration with learners (Haaranen et al., 2014), and as a reason to engage with employers in curriculum design (O’Byrne et al., 2015).

Chapter 3 Methodology

3.1 Introduction

This chapter presents the research methodology aimed at addressing the research questions in a valid and reliable manner. The over-arching philosophy of the research is that there should be a practical output to inform practitioners considering the use of digital open badges in their practice, and therefore a practical approach to methodology and methods has been adopted. Table 3.1, below, summarises the timeline for the main activities in the research.

Table 3.1 Timeline for the research study

Date	Activity
Started May 2016	Literature review process began
October 2016	Questions for surveys and interviews developed
November 2016	Introduction to digital open badges with students. Phase 1 Student survey conducted
December 2016	Student reflective journals collected and student interviews completed
January 2017	Phase 1 Interviews with other stakeholders completed
February 2017	Data analysis commenced
April 2017	Phase 1 Study Report completed
July-August 2017	‘Starter Pack’ of digital open badges developed
September 2017	Digital open badges introduced to students, pre-delivery survey completed. First digital open badges issued
January 2018	Initial analysis of pre-delivery survey responses, to aid development of post-delivery survey questions
April 2018	Post-delivery survey conducted
September 2018	Initial data analysis of pre- and post-delivery survey data
December 2018 to January 2019	Development of student interview questions
February 2019	Interviews with student participants
March to June 2019	Further quantitative and qualitative analysis
August 2019	Interviews with institute manager and employer
March to October 2019	Thesis development and writing up

3.2 Philosophical approach

3.2.1 Ontology

According to Bryman (2012), there are two opposing world views, ‘objectivism’ and ‘constructionism’ (p.32). Objectivism implies that social phenomena are external to us and that we have no influence over them. The approach taken in the research is that of constructionism, following how Bryman (2012) describes constructionism as a more dynamic reality, constructed by context, actors and the interactions between them.

3.2.2 Epistemology

Epistemology can be divided into positivism (knowledge is acquired by imparting hard facts) versus interpretivism (knowledge is gained by experience and interpretation) (Bryman, 2012; Mingers and Brocklesby, 1997). Positivism is suited to studying natural sciences, but interpretivism is more suited to social science research (Bryman, 2012). Due to the predominantly subjective nature of the research, interpretivism is the more appropriate epistemological stance, where the focus will be on understanding and explaining the views and behaviours of the participants.

3.2.3 The role of the researcher

When explaining the views and behaviours of the participants, the influence of the researcher on how those participants report and behave is important to consider. There is a risk that students may feel they have to report in a way that they feel the researcher is expecting. This was addressed by ensuring the relationship in class was maintained as a lecturer-student relationship throughout the research, apart from approximately one hour at the beginning of module delivery with each cohort when the research was explained and consent to participate sought.

3.3 Methodology

This section describes the style and methodology used in this research.

3.3.1 Research style

The overall process for this study can be described as a case study using elements of action research. One of the strengths of a case study, according to Cohen et al.

(2011), is that they ‘observe effects in real contexts, recognising that context is a powerful determinant of both causes and effects’ (p.289). This aligns with the purpose of this thesis, i.e. to understand the how, why and what effect of using digital open badges in the context of a civil engineering degree. The aim of action research is to improve practice (Elliott, 1991) through generating greater understanding and knowledge of educational practices (McAteer, 2013). In this thesis, the improvement being sought is increased student engagement and motivation. The proposed mechanism for making the improvement is the use of digital open badges. Laanpere et al. (2014) offer a model for designing pedagogy-driven digital content, where participants have an input. Although the Laanpere et al. (2014) context is different, the iterations of research-based design that they offer provides a useful framework for implementing a digital open badge scheme. The Laanpere et al. (2014) framework has been adapted to more accurately reflect the current study, as shown in Figure 3.1, below:

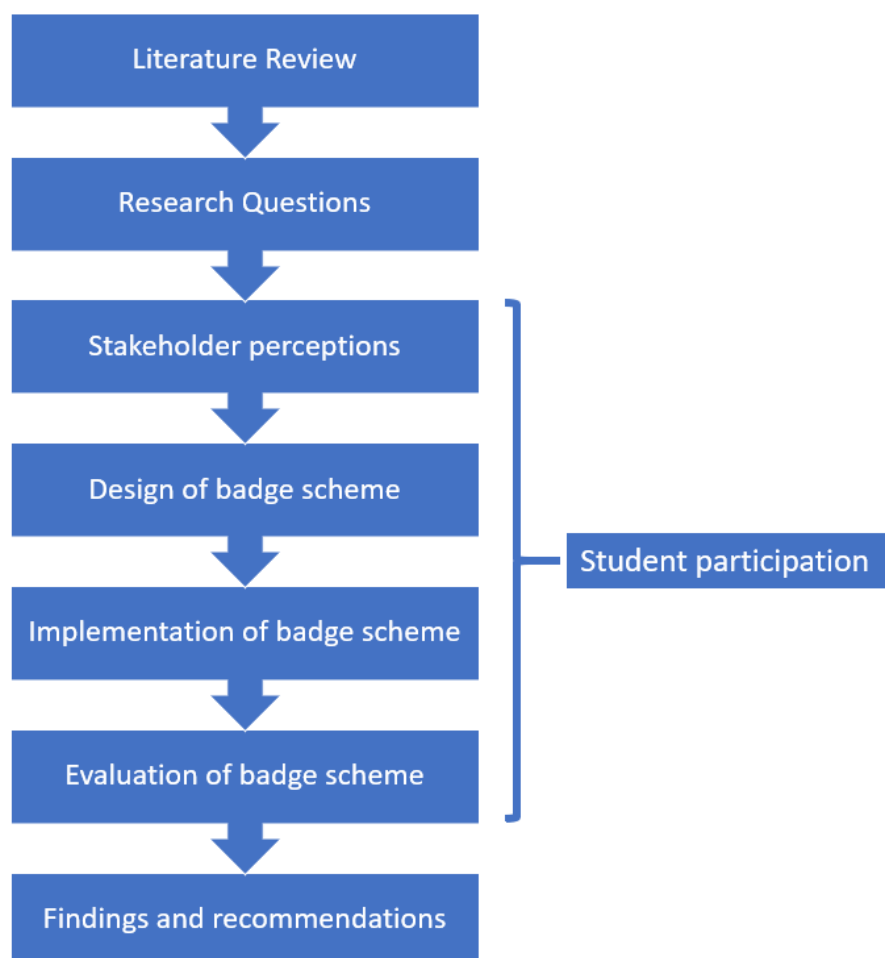


Figure 3.1 Framework for the research into the use of digital open badges

Student participation, through surveys, reflective journals and interviews occurs at four key stages in the framework, reflecting a student-centred approach. Research Question 1 (“What role do key stakeholders - students, staff, management and employers - see for digital open badges in teaching and learning within the higher education sector?”) is addressed at the “stakeholder perceptions” stage in Figure 3.1, above. An additional output from that phase is the development of the ‘Starter Pack’ of digital open badges. It is the perceptions and effects of this ‘Starter Pack’ that form the basis of the delivery and evaluation of the digital open badge scheme which address Research Questions 2 and 3.

3.3.2 Research methodology

Traditionally, quantitative research involves collecting and analysing numerical data, and qualitative research involves narrative data (Hayes et al., 2013). De Vaus (2001) warns us that it is a mistake to equate a particular approach with either quantitative or qualitative methods: this is an argument for the complexity of social research, and a hint that a more flexible and pragmatic approach to methods is favourable. Flexibility would seem to be a good fit for action research, where iterations and evaluations require an open and inclusive approach. Therefore, the approach taken aligns with pragmatism, using a mixture of methods to address particular research questions. In order to build a profile of the student participants and develop the ‘Starter Pack’ of digital open badges (Research Question 1), data collection took the form of a questionnaire, interviews and reflective journals. Similarly, Research Questions 2 and 3 are addressed using a combination of surveys and interviews. By combining these approaches, the overall research methodology aligns with what has been described as a mixed methods approach (Creswell and Plano Clark, 2011; Wisdom et al., 2012). Bryman (2012) contends that contrasting qualitative and quantitative approaches makes them seem incompatible, but that it is possible to combine them (p. 38). Jarvela et al. (2010) suggest that an appropriate way to investigate the motivational benefits from working with others is to use a triangulation of observations, questionnaires and interviews.

The three research questions are:

RQ1. What role do key stakeholders - students, staff, management and employers - see for digital open badges in teaching and learning within the higher education sector?

RQ2. What processes and practices enable participatory digital open badge use by students and teachers?

RQ3. How do digital open badges impact on learning, learner motivation and engagement and institutional teaching processes?

3.4 Methods

The methods employed for the Phase 1 stage of the study were surveys, reflective journals and interviews with students and interviews with the other stakeholders. For the Phase 2 study, the focus was on the student stakeholder group, consisting of surveys and interviews, followed by interviews with institute management and an employer. This section describes these methods, and the sampling and ethical considerations involved.

3.4.1 Phase 1 study sampling

All students in Year 1 and Year 4 (2016/17 academic year) were invited to participate in the study, and all present on the day of the survey took part (n=45 in Year 1 and n=9 in Year 4). These year groups were chosen because they each had CAD-type modules being delivered by the author. Voluntary self-selection by the members of the classes was used for both the interviews and the reflective journal. All members of the population were invited to volunteer for these activities as part of the survey. Given that the number of volunteers was relatively small, and a further call made via email to the classes did not yield any additional volunteers, all of the students who volunteered (n=4 for interviews and n=3 for the reflective journal) were selected to take part. For the teaching staff, institute management and local employer, purposive sampling was used. These participants were selected on the basis that they are 'knowledgeable people' (Cohen et al., 2011, p. 157): they each have in-depth knowledge about the context being researched. Teaching staff knew the class members, institute management have a bigger picture view of the politics influencing teaching practice, and the employer has

knowledge about the skills, competencies and traits desirable in graduates. The employer has a track record of recruiting graduates from the Civil Engineering programme in recent years and he represents a multi-disciplinary engineering consultancy firm with 5,200 employees operating in 125 countries. The consultancy firm has 610 employees and an annual turnover of €51 million in Ireland. The Galway office of this firm is typical of similar consultancies in the region. A summary of the stakeholders in Phase 1 is shown in Table 3.2, below.

Table 3.2 Summary of Phase 1 participants

Stakeholder	Role	Interview participants		Survey participants		Reflective journal participants	
		invited	volunteered	invited	responses	invited	volunteered
Students	Year 1 students	45	2	45	45	45	2
	Year 4 students	9	2	9	9	9	1
Teaching staff	Civil Engineering Lecturer (Year 4)	2	2				
Management	Head of Department, Building and Civil Engineering, GMIT	1	1				
Employer	Local office of multinational Engineering Consultancy firm	1	1				

3.4.2 Phase 1 study methods

Survey

The purpose of conducting the survey was to develop a profile of the student participants, both the first year and fourth year classes. The survey took the form of an online questionnaire. Google Forms was chosen as the survey instrument because it is free and because it can be set up to create a spreadsheet live and automatically as responses are given. Newby (2014) offers practical guidance of how to design a survey, such as using existing questions where possible. Likert-scale type questions were used to gather data on how the students view their own motivation. The questions used were extracted from the work of Elliot and Church (1997) and the intrinsic motivation inventory (Self Determination Theory, n.d.). A transcript of the survey administered is shown in Appendix 1. The Elliot and Church (1997) questions are based on achievement goal theory and are aimed at identifying the type of motivation being reported (extrinsic or intrinsic). The

intrinsic motivation inventory questions are intended to measure the level of motivation rather than the quality of it.

In addition to capturing motivation type and level, the survey had several intended roles: primarily to gather numerical data on student CAO entry points and their own views on motivation (as captured by likert-scale responses). There were two reasons for including student CAO entry point information: firstly, to identify the extent of at-risk students in the class (i.e. those entering with previous academic performance which could affect their likelihood to progress) and secondly to facilitate analysis comparing entry point attainment to subsequent performance in higher education. Other roles include a means of introducing students to the concept of digital open badges, to capture early impressions as to what aspects of the programme to consider for the digital open badge scheme and as a means of recruiting volunteers for interviews.

The survey instrument was validated by pre-testing it with a colleague and a family member. This helped identify ambiguity of instruction, ease of completion, timing and spelling issues.

To ensure there was a consistent way of introducing the concept of digital open badges to all participants, a short (2-minutes) video animation was developed. This video was shown to participants just prior to participation in the survey. The video is available online at the following address: <https://youtu.be/i5KAdMvakH8>

Interviews

The Phase 1 study included interviews with a number of stakeholders: students, teaching colleagues, institute management and an employer. The introductory video animation was shown to each participant prior to interview as a means of presenting a consistent background to the concept, roles and sample use-cases for digital open badges. The first student interviewed indicated that he had difficulty reading the text of the animation, and so it was read for him prior to the interview: resulting from this a second, narrated version of the video was created and subsequent participants were given a choice as to which version they wished to view. Originally, the plan was to analyse the data from the student participants before interviewing teaching staff. The idea behind this approach was that the student responses would inform the type of questions to be asked at the staff

interviews. In turn, the staff interviews would be analysed prior to institute management interviews, and institute management interviews would be analysed prior to employer interviews. Student participant recruitment took longer than anticipated, however, and the planned approach had to be altered due to time constraints. The interviews were semi-structured, modelled on the flexible ‘interview guide approach’ as defined by Cohen et al. (2011, p.413). This approach aligns with Assiter and Gibbs (2007), who also used semi-structured interviews when researching the link between motivation and retention. The interviews with students were about fifteen minutes in length, resulting in about two hours of transcribing time each. A transcript of the open-ended questions asked of student participants is shown in Appendix 2. The other stakeholders had more to say, and those interviews were approximately thirty minutes each. Appendices 3, 4 and 5 provide transcripts of the open-ended questions used with these stakeholders.

Learning journal

Hubbs and Brand (2010) define a reflective journal as ‘a written narrative that facilitates on-going disclosure of the writer’s cognitive and emotional insights....a vehicle for chronicling the writer’s internal processes about experiences, values and beliefs’ (p. 59). The use of a reflective learning journal to gather data aligns with what Cohen et al. (2011) describe as ‘accounts and episodes’ (p. 445). By recording the thoughts of the student participants (accounts) over several classes (episodes), the aim was to elicit data that is honest and reflective of more than just a snapshot of views (such as may be gathered at interview stage). Students in both classes (first and fourth year) were invited to participate in the research by completing a reflective learning journal. As part of the recruitment process, the students were presented with a list of non-exhaustive questions as a suggestion of how to approach writing the reflective journal.

3.4.3 Phase 2 study sampling

The focus of Phase 2 is to investigate the processes and impacts of using digital open badges with first year students. In Phase 1 the stakeholder involvement was broader: the reason for this was to include as many stakeholder groups as possible in order to establish the perceptions, roles and expectations when designing the

'starter pack'. In phase 2, the emphasis shifted to those most directly involved in the study: the Year 1 students eligible to earn the badges. The Year 4 students were not involved in earning badges during Phase 2, and as they were a different cohort to the Year 4 students in Phase 1, they had no knowledge of the scheme. The emphasis on Year 1 students in Phase 2 is justified by the fact that motivation was being investigated in the context of retention: this is not relevant for Year 4 students. In addition, the GMIT management has targeted the 'first year experience' as the focus of its campaign on retention. Therefore, it makes sense to focus on the implementation on that group. The lecturing staff taking part in Phase 1 did not have any further awareness or knowledge about the implementation, and so are unlikely to have been able to make any further input subsequent to that already presented in Phase 1. One of those lecturers is no longer employed at the GMIT. The Institute Manager and employer were included in Phase 2 as they had an ongoing interest and awareness of the scheme, so their input was useful for reflecting on it. A summary of the stakeholders in Phase 2 is shown in Table 3.3, below.

Table 3.3 Summary of Phase 2 participants

Stakeholder	Role	Interview participants		Pre-delivery Survey participants		Post-delivery Survey participants		Number of students common to pre- and post-delivery survey
		invited	volunteered	invited	responses	invited	responses	
Students	Year 1 students	44	4	52	49	44	40	37
Management	Head of Department, Building and Civil Engineering, GMIT	1	1					
Employer	Local office of multinational Engineering Consultancy firm	1	1					

All members of the Year 1 class (2017/18 academic year) were invited to take part in the surveys. At the time of conducting the pre-delivery survey (September 2017), the class population consisted of 52 students. 48 of those were present on the day of the survey, and all 48 agreed to participate. At that stage in the

academic year, the students had only just begun their studies, and had taken part in two introductory CAD classes. To ensure all students in the class were given the same opportunity, the four students not present were invited to take part via an email invitation. Only one of those four replied and agreed to take part. Total number of participants was therefore 49 out of 52 students.

At the time of conducting the post-delivery survey, some students had withdrawn from the course; 44 active students remained. Each of the remaining students was invited to participate in the survey via email and in-class announcement one week prior to the survey date. In total 40 students took part in the post-delivery survey, conducted in April 2018. Of that 40, 37 had also taken part in the pre-delivery survey, and so the number of valid responses that can be used for a pre- and post-delivery comparison is 37.

Student participants in the post-delivery survey were invited to volunteer for the interview stage. Of the 40 students that participated in that survey, three students agreed to take part in the interview stage. In addition, the recipient of the 'Best Mentor in Class' digital open badge was separately invited via email to volunteer subsequent to achieving that digital open badge and he agreed to take part in the interviews. All four volunteers had taken part in both the pre- and post-delivery surveys. There seems to be a large range in what is considered an adequate sample size for qualitative research (Creswell, 1998; Morse, 1994). According to Cohen et al. (2011), there are no clear rules on the size of the sample, and they suggest a more appropriate approach is 'fitness for purpose' (p.161). Such fitness for purpose in this thesis is centred on how the student interviewees are considered representative of the cohort in terms of the type of digital open badges they earned, and the final grades they achieved.

There are four categories of digital open badge in the study:

- Skills mastery based (high achievement in an assessment, levelling up, improving between assessments)
- Performance based (achieving best grade in two key assessments)
- Peer based (issued via peer nomination)
- Mystery badges (description and mechanism for earning was not explained to the students in advance)

Three of the volunteers obtained digital open badges from some or all of these categories (the fourth student failed the module and did not earn any digital open badges apart from the on-boarding one). Therefore, it is argued that representation based on type of digital open badge obtained has been achieved. However, one of the relationships being explored in the quantitative analysis is the potential link between number of digital open badges obtained and overall final grade.

Therefore, in addition to recruiting interview volunteers who cover all four categories of digital open badge, the intention was to include interviewees to represent a spread of final grade results. The four volunteers already recruited had obtained final grades in the CAD module of 21%, 67%, 77% and 80%. The volunteer achieving 80% represents the highest final grade in the module. Only two students in the class (who had not volunteered to interview) achieved a grade lower than the 21% achieved by one of the volunteers. Therefore, it is argued that using a final grade-based criterion, the highest and lowest achievers in the class are represented by two of the volunteers. The remaining two volunteers represent above average achievers (the average final grade for the class being 56%). There appears to be a gap, therefore, in the volunteers around the average, or below average final grade. To balance the two volunteers that are above average, the aim was to recruit two below average, and one at or around the average final grade. In total, this gave a target number of seven interviewees. To address this, a further call for volunteers was made to the entire class, via email and in-class appeal. As an incentive, all interviewees were given a lunch voucher, and their names were placed into a draw for a gift voucher. Even with these incentives, no further volunteers emerged, and so the number of student participants for interviews remained four.

The institute manager and employer interviewed in Phase 1 were interviewed a second time to address issues emerging from the analysis of the student interviews in Phase 2.

3.4.4 Phase 2 study methods

Pre-delivery and post-delivery surveys

To be able to compare responses over time, the surveys included a question at the start which asked for student identification number. Participants were assured that

this was required for the purpose of comparing responses at a later date and had no impact on confidentiality, anonymity and/or data protection, all of which are assured in the consent form.

The survey instrument was validated by pre-testing it with a colleague and a family member. This helped identify ambiguity of instruction, ease of completion, timing and spelling issues.

To ensure there was a consistent way of introducing the concept of digital open badges to all participants, a short (2-minutes) video animation was developed. This video was shown to participants just prior to participation in the survey. Again, the video is available on YouTube at the following address:

<https://youtu.be/i5KAdMvakH8>

One of the aspects to be measured over time is the level and quality of motivation. Two questions were included in each survey to address this aspect. One question was a modified version of the Intrinsic Motivation Index (Self Determination Theory, n.d.), aimed at identifying the level of motivation. The second question included relating to motivation, which was based on the work of Elliot and Church (1997). Hegarty (2011) sees a distinction between Self-Determination Theory (SDT) and Achievement Goal Theory (AGT): he contends that AGT is suitable way to identify the type of motivation (skills mastery, performance-approach or performance-avoidance) while SDT is suitable for measuring the strength of motivation.

Self-Determination Theory was developed by Deci and Ryan (1985) as part of their exploration of Achievement Goal Theory (AGT). They devised the Intrinsic Motivation Index (IMI) questionnaire as a data gathering tool and it has been primarily used in other studies to establish type and strength of motivation at one instance in time. To use the IMI in the research at hand, a modified version of the questionnaire was developed. The nature of the modification was that the original IMI questionnaire was written to suit being applied after an event, and this was changed to suit a “pre-delivery” style for the current study. Modifications to the IMI have precedent. For example, McCord and Matusovich (2013) modify the IMI to measure motivation levels in engineering students, and Amarose and Horn (2001) modify the questionnaire for use in a pre- and post-intervention setting. In

McDaniel and Fanfarelli (2016) we find further evidence of the Intrinsic Motivation Index being deemed an appropriate way to measure motivation. The “pre-delivery” version used in the current study is shown in Appendix 7 (as “Question 3”), and the “post-delivery” version is shown in Appendix 8 (as “Question 2”).

The second question used in the surveys relating to motivation is based on the Achievement Goal Theory work of Elliot and Church (1997). This is another method used to measure intrinsic motivation. In the Phase 1 study, this set of questions was modified to include terms such as “module” and “CAD”, which did not appear in the original Elliot and Church (1997) questionnaire. In the pre-delivery survey in Phase 2 study, this questionnaire appears exactly how it was presented in the Phase 1 study survey. When re-used in the post-delivery survey, the tense for each of these questions reflects the timing of the survey (i.e. the module and exposure to digital open badges was complete). The “pre-delivery” version used in the current study is shown in Appendix 7 (as “Question 5”) and the “post-delivery” version is shown in Appendix 8 (as “Question 3”).

Other aspects included in the surveys address the student perception and prior knowledge of digital open badges, their attitudes towards gaming and their academic achievements (CAO entry points) at commencement of the module. The reason for including questions relating to perceptions is to allow comparison with the Phase 1 study and to address uncertainties and gaps identified in the literature review. The surveys also included questions relating to roles for digital open badges, offering the participants an opportunity to suggest ideas for the digital open badge scheme. There was some ambiguity regarding gamification in the literature review, and so the Phase 2 study survey included questions aimed at identifying the student perceptions to that in this context. The pre-delivery survey also included a question relating to the student’s prior academic achievement, in the form of stating their CAO entry points. This question was included so that relationships between previous academic ability and engagement and performance with the module can be investigated. In addition to the survey responses collected, four extra sets of data were included for each participant. These are (a) percentage attendance at the module, (b) final grade obtained in the module, (c) number of digital open badges eligible for and (d) number of digital open badges claimed.

Interviews

Student participants in the post-delivery survey were invited to volunteer for the interview stage. The interviews were semi-structured, modelled on the ‘guidelines for the conduct of interviews’ as defined by Cohen et al. (2018, p.521-522). This approach aligns with Assiter and Gibbs (2007), who also used semi-structured interviews when researching motivation. The set of interview questions is shown in Appendix 9. Each interview was audio recorded, using a main device and a back-up recording device. The main device (iPhone 6) was running an audio recording application called “Otter”, the main function of which is to live transcribe audio to text. The resulting text required edits for accuracy, which had the dual purpose of correcting the text and at the same time being an effective first listen-back to the content. To ensure reliability, a transcript was sent via email to each participant for review. All interviewees confirmed accuracy without any suggestions for changes.

3.4.5 Phase 2 interview questions for students

In addition to interview questions aimed at addressing ambiguities/uncertainties in the literature review and Phase 1 of the study, the Phase 2 study survey responses lead to the formation of interview questions to further investigate emergent issues. These interview questions and the rationale for their inclusion is shown in Table 3.4, below. It should be noted that the wording for the interview questions uses the term ‘badge’ or ‘badges’ to mean digital open badges.

Table 3.4 Phase 2 student interview questions and rationale

Question	Rationale
1. What particular type of badge do you have a preference for? Why?	Given the range of types of digital open badges on offer, and the various mechanisms for earning them, this question aims to establish which digital open badges the students like the most. Essentially the types are: linked to high performance in an assessment, associated with a ‘best in class’ performance in an assessment, for showing an improvement between assessments, for showing an improvement for a second attempt at an assessment,

	for 100% attendance, and for mentoring. The responses to this question will indicate areas of focus for future digital open badge development.
2. Would you want to earn any of these badges and why?	This question aims to establish the type and extent of desirability of the digital open badges for the students. Responses will highlight the value proposition of the digital open badges for the students.
3. Was there a badge that you really wanted to get, but didn't? Which ones? Were there any badges you just weren't interested in and why?	By asking about digital open badges that were desired but not obtained, the aim is to clarify what it is about a digital open badge that makes it attractive to the students. The question of which digital open badges (if any) were of no interest will inform future development of similar schemes, where digital open badge types deemed to be of no interest may be considered for omission.
4. Did you claim all of the badges that you were eligible for? Why/why not?	The relationship between number of digital open badges claimed and academic performance has been demonstrated in the survey data analysis. Considering the 76% claim rate for the digital open badges, this question will probe the reason why the student did not claim all the badges, with a view to informing the scheme design to encourage more uptake. If the interviewee states that they did claim all eligible digital open badges, the justification they provide for doing so will add further explanation of the value proposition the digital open badges offer.
5. Did the badges motivate you in your studies?	Answers to this question will reinforce/contradict the concept that the digital open badges act as a motivational device for the students. It is left open for the students to explain in what way(s) the digital

	open badges were or were not motivational for them. Responses will inform the role of digital open badges that the students consider most motivational.
6. How involved in the digital open badge process did you feel?	This question relates to the participatory process and practice of designing and engaging with the digital open badges scheme. The responses will provide a student-voice for the manner in which the digital open badge scheme is designed and implemented. This question provides an opportunity to discuss the peer-nomination process, where a mixed-response emerged from the survey data (and the literature review).
7. Would you like to see badges in other modules in Year 1, and/or carried through the CAD module into Year 2? If so, for what reason?	The responses to this question will identify whether the students see value in the digital open badges being used in a context other than the CAD module in Year 1.
8. What activities, behaviours or accomplishments would you like to see badges awarded for? Why do/do not the present set meet these?	This question aims to establish whether the current ‘Starter Pack’ of digital open badges on offer meets the expectations of the students. Aspects which the student identify as being important that are not already included will help with the development of future versions of the digital open badges set.
9. Did you share any of the digital	The uptake of sharing to social media was lower than expected, and this question will offer some

<p>open badges you earned?</p> <p>Why/why not?</p> <p>Where?</p>	<p>insight into why. For example, it may be because the students shared their digital open badges in some way other than on social media. The explanation given for why/why not and where will be useful in the design of future digital open badge schemes.</p>
<p>10. Did you like the way in which the Mystery Badges were run? Follow ups: Did the transparency/lack thereof influence engagement with the badge award scheme? If you had known the mechanism for earning in advance, would it have affected your behaviour? Why/why not?</p>	<p>There are some mixed reports in the literature about digital open badges that are hidden and/or have hidden earning mechanisms. This question aims to ascertain the students' perspective on the manner in which the Mystery Badges were implemented in this study. Of particular interest will be whether the students view lack of prior knowledge of earning mechanism as a positive or negative feature, and whether such knowledge, if made available at the start of the module, would have influenced their behaviour on the module. The findings will be useful in the design of future implementations of the digital open badge scheme.</p>

3.4.6 Phase 2 interview questions for institute management

Following the analysis of the Phase 2 student interviews, issues emerged which were addressed through further interviews with the institute manager and the employer who had taken part in the Phase 1 stage of the research. The questions for institute management and their rationale for inclusion are shown in Table 3.5, below. Again, it should be noted that the wording for the interview questions uses the term 'badge' or 'badges' to mean digital open badges.

Table 3.5 Phase 2 management interview questions and rationale

Question	Rationale
1. Reflecting on the various types of badges made available, which one do you see as being most valuable for the students? Why?	Given that the student perspective identified multiple digital open badges as being valuable for a number of reasons, this question seeks to identify which digital open badge is regarded as most valuable to the students from the institute perspective. This question is important as it will help identify digital open badges to include in future roll out of the scheme.
2. Likewise, which one do you see as being most valuable for the Institute? Why?	This question aims to ascertain which digital open badge is viewed as most valuable to the institute. This is important, as it acknowledges that the institute and the students can have a view on the value of digital open badges. It makes the assumption that the institute values digital open badges in the first place. The response to this question will support that assumption and identify the type of digital open badges that are most likely to be supported by the institute in future roll outs.
3. Having read the description of the ‘level-up’ badge, what message do you think it sends out about the earner?	There were different interpretations by the students regarding the message of this digital open badge. This question seeks to understand how that digital open badge is interpreted by institute management and ascertain whether that interpretation is different to or supportive of a particular student perspective. This question is important as it reflects how different stakeholders can interpret different meanings onto the digital open badges; a challenge to the design of a digital open badge scheme identified in the literature review.

<p>4. Do you see the badge scheme as something worth considering in other modules/programmes?</p>	<p>This question seeks to clarify the institute perspective on the potential for using digital open badges more broadly in the programme and/or department. The student view was that there is a role for digital open badges elsewhere, and so this question aims to ascertain the interest of the department in whether and how that view can be supported.</p>
<p>5. Are there issues in the department which badges might help with?</p>	<p>This question seeks to identify whether issues exist that digital open badges can help address. This is important as the response will help to understand not only if institute management see a role for digital open badges in the department, but also which type of digital open badges to focus on. This could be digital open badges already trialled in this thesis or badges with a role not included in the ‘Starter Pack’.</p>
<p>6. Do you think there are any challenges for rolling it out?</p>	<p>This question makes the assumption that the institute is willing to roll out the digital open badges scheme more broadly and seeks to identify what the challenges to that are. By identifying the challenges at this stage, there is an opportunity to address them prior to any future development of the scheme. The response will offer insight into what the institute sees as potential risks to future implementation.</p>
<p>7. How do you think the roll out would be done in a practical way?</p>	<p>This question seeks to identify the practical issues with rolling out a digital open badge scheme, with the intention of understanding how the scheme can be made more broadly available within the institute. This is important because if the digital open badge scheme is to</p>

	<p>be adopted in some form, then foresight into how this can be done would be helpful in achieving stakeholder buy-in and early detection of potential obstacles.</p>
<p>8. What advantages and disadvantages do you see for digital badges?</p>	<p>This question was asked of the same interviewee in the Phase 1 stage. The question seeks to identify not only any advantages or disadvantages that the institute can see for a digital open badge scheme, but also to facilitate an investigation into changes in attitude towards the scheme over time. The response is important as it will help understand how the institute management views digital open badges, with the intention that this will inform future implementations of the scheme.</p>
<p>9. How do you think we can build trust in the badges?</p>	<p>This question was asked of the same interviewee in the Phase 1 stage. The question assumes that the digital open badges require a level of trust that has to be fostered and increased so that the scheme is credible for stakeholders. Such credibility is not only important, but as seen in the literature review, difficult to obtain. Therefore this question is important as it will help identify steps to be taken which, in the view of the institute, will build trust.</p>
<p>10. What do you think about a student interpreting the level-up badge negatively?</p>	<p>This question is aimed at further investigating the institute management view on the digital open badge raised in question 3, above. This is important due to the negative interpretation expressed by one student (the other three students held a positive view about this digital open badge) which has created ambiguity about</p>

	<p>the value of the ‘level-up’ digital open badges. As the negative view was an outlier from the student perspective, the aim of this question is to investigate if institute management shares this view or if it supports an alternative interpretation. This is important, as it addresses the issue of shared meaning for the digital open badges, something which is difficult to negotiate.</p>
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3.4.7 Phase 2 interview questions for employer

Following an analysis of the student interviews, issues emerged for which clarification was required. The questions shown in Table 3.6, below, were developed to address these issues from the perspective of the employer. Again, it should be noted that the wording for the interview questions uses the term ‘badge’ or ‘badges’ to mean digital open badges.

Table 3.6 Phase 2 employer interview questions and rationale

Question	Rationale
1. Reflecting on the various types of badges made available, which one do you see as being most valuable for the students? Why?	This question was asked of the institute manager in the Phase 2 stage also. The aim of asking this question is to record the employers view on the value of digital open badges for the learners. This is important as it relates to shared meaning; will the employer and institute see the same digital open badge as most valuable to students? If so, will these two stakeholders give the same reasons? If not, what are the attributes of the digital open badges chosen that make them more valuable in their view?
2. Likewise, which one do you see as being most	This question seeks to identify which digital open badge is deemed most valuable to the

valuable for employers? Why?	employer. This refers to when the employer is the consumer of the digital open badge, which has been shared with them by a prospective employee at the job application stage. This question is important as the response will highlight the type of digital open badge to be included in the development and future implementation of the scheme.
3. Having read the description of the 'level-up' badge, how do you interpret the message it sends out about the earner?	This question is aimed at investigating the same issue that is addressed in the interview with institute management about this digital open badge. There were multiple interpretations provided by the students regarding the meaning of this digital open badge. One student stated that they would not share the 'level up' digital open badge when communicating with prospective employers, as they felt it would send out a negative message about the earner. This question is important because the employer will provide clarity on how they view the 'level-up' digital open badge.
4. Do these digital badges add value to a CV? Do they provide any useful information that might otherwise be missing?	Given the role that students see for digital open badges when seeking employment, this question aims to investigate how the employer would view digital open badges if presented on a CV. This is important because if the employer identifies clear benefits to including digital open badges on a CV, then this can be communicated to the students in a future implementation of the scheme.

<p>5. What are your reflections on participation and engagement with the scheme?</p>	<p>This thesis advocates for the inclusion of multiple stakeholders in the design stage of the digital open badge scheme, including employers. Therefore, it is important to understand how involved the employer felt with the process. This question seeks to explore the nature and extent of employer involvement, with the aim of supporting the view that consultation with the employer was to a sufficient standard. Recommendations provided in response to this question will be considered in a future implementation of the scheme.</p>
<p>6. How do you think we can build trust in the badges?</p>	<p>The credibility of the digital open badge scheme is vital to its success, especially if the digital open badges are shared with prospective employers as part of job applications. This question was asked of the institute manager also, and of the employer during the Phase 1 stage. This question is important as it aims to provide focus on how credibility can be built; whether it is an aspect that is within the control of the issuer or the earner.</p>
<p>7. How would you suggest going about engaging other employers?</p>	<p>This question assumes that the employer views the digital open badge scheme as something worthy of wider engagement. Responses to earlier questions will support this assumption. The aim of this question is to identify the next steps that the employer views as being the most effective in making the digital open badge scheme more visible for employers. This is important, because if</p>

	the digital open badge scheme is seen as being valuable to employers, then a clear strategy for engaging more employers is central to the success of future implementations.
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3.5 Ethical considerations

British Education Research Association (BERA, 2011) guidelines and templates from The Open University were used to make an application for ethical clearance during the Phase 1 study. This was granted by the Human Research Ethics Committee (HREC) on 17th October 2016, and is valid for the duration of the research. The HREC grant was considered sufficient to meet the ethical considerations of the Galway-Mayo Institute of Technology (GMIT). The choice of research tools influences the extent of the ethical considerations. Essentially, all participants are given two documents: an information leaflet which they keep, and a consent form which they sign and submit for record purposes. In addition to consent forms, all participants were assured of anonymity (pseudonyms to be used if direct quotes are included), informed about data protection, informed about the implications of participating (or not) and afforded the right to withdraw from the research. Since May 2018, participants have been given further assurances that the privacy and data protection afforded by General Data Protection Regulation (GDPR) applies to their involvement in the research.

3.6 Data analysis

3.6.1 Survey analysis

The aim of the survey was to develop a profile of student academic background, self-reported motivation, prior knowledge of digital open badges and perceptions of digital open badges. Further, by utilising both pre- and post-delivery survey data, changes over time can be explored. This data was used for both descriptive reporting and inferential statistical analysis. The Phase 1 study included sections on descriptive statistics and a discussion around them in the context of answering research question number one. For the Phase 2 study, where potential

relationships are being examined, inferential statistical analysis was used to interpret deeper meanings. Two of the questions in the survey (each asked in both the pre- and post-delivery surveys) are based on work discovered in the literature review and are analysed using scoring systems established by Elliot and Church (1997) and the intrinsic motivation inventory (Self Determination Theory, n.d.). Elliot and Church (1997) contend that high levels of intrinsic motivation correlate to an expectance of high academic performance. In their analysis, Elliot and Church (1997) conduct a factor analysis on the questions asked, to support partitioning the student attitudes into performance-driven, skills mastery and performance avoidance components. The same approach was used in this thesis to determine if the sample was similarly partitioned in this case. Similarly, a factor analysis of responses to the questions based on the intrinsic motivation index (Self Determination Theory, n.d.) has been carried out to verify if the three categories are present (the three factors posited are interest/enjoyment; value/usefulness; perceived choice). See Appendix 10 for details on the factor analysis used.

A comparison of the Phase 2 student retention rate to previous years was not possible, as progression data were not available at the time of writing. However, retention is beyond the scope of this study: the aim here is to explore roles and impacts of digital open badges in terms of engagement and motivation rather than retention.

3.6.2 Descriptive statistics

Descriptive statistics are used to report on the mean, frequency distribution, range and standard deviation of responses given using a Likert scale. Further, the participants' attitude towards digital open badges, gamification, peer assisted learning and networking are presented using descriptive analysis. Precedent for such an approach when researching digital open badges is found in Harmon and Copeland (2016), McDaniel et al. (2012) and Santos et al. (2013). Where questions were used in both the Phase 1 and the Phase 2 study surveys (i.e. the intrinsic motivation index and the achievement goal theory questions), there is an opportunity to compare the student responses across two years to establish whether the responses in the Phase 2 study are typical. This is done by comparing the mean and standard deviation of responses. Crosstabulation is used to present data associated with different subsets within the sample (for example, motivation

levels presented in tabular format where the sample is divided into the CAO entry point ranges). Thematic analysis will be used when summarising responses to open-ended questions in the surveys.

3.6.3 Inferential data analysis

To assess the influence of previous academic performance (secondary level) on performance and interaction with the digital open badge scheme on the module, the following question is investigated:

- Is there a relationship between CAO entry points and attitude to badges, number of badges earned, type/level of motivation, and academic performance in the module?

To address Research Question 3, the following key questions are investigated using inferential data analysis:

- Is there a relationship between the number of digital open badges earned and academic performance in the module?
- Is there a relationship between attendance and number of digital open badges earned and/or academic performance in the module?
- What change (if any) is there in learner motivation over the course of the academic year?

The sub-questions presented here include independent and dependent variables. For example, CAO entry points can be considered an independent variable and the number of digital open badges earned could be one dependent variable tested against CAO entry points. Likewise, the number of digital open badges earned could be considered an independent variable against which the final grades (dependent) can be tested. In addition to differences between groups, some the sub-set of questions above are addressed by exploring correlations. Correlations are used to determine relationships between two variables (Hinton and McMurray, 2017). An example here is to investigate the relationship between the number of digital open badges earned and overall final module grade. The Pearson test is an appropriate method for such investigation into the effect that two variables may have on each other, and the statistical significance of any relationship thus found (The Open University, 2007).

In order to test the sub-set of questions above, they are posed using the format of the null hypothesis (Cohen et al., 2018, p.744). Testing is carried out to establish whether there is support or no support for the null hypothesis, with the starting assumption that the null hypothesis is ‘true’ (Cohen et al., 2018, p. 744). Where a test shows significant lack of support for the null hypothesis (this study uses $p < 0.05$), an alternative hypothesis is supported. There is precedent for such tests being used in studies on digital open badges. In a study that has some similarities with the one at hand, Reid et al. (2015) employed survey questions based on the intrinsic motivation index (IMI) and attitudes to digital open badges. Reid et al. (2015) conducted multiple surveys to record changes in IMI over the course of a semester, and then performed independent samples t-test to investigate any potential differences between each group and changes in motivation over time due to earning digital open badges. Fanfarelli and McDaniel (2017) investigated relationships between quantities of digital open badges earned and student engagement and performance using correlation analysis and regression analysis. They used correlation analysis to obtain the Pearson correlation coefficient r (for example, to investigate whether the number of digital open badges earned differed by gender). They used regression analysis to explore the predictability of outcomes based on digital open badge eligibility (for example, whether the number of digital open badges earned can be used to predict final module grade). Fanfarelli and McDaniel (2017) state that statistical significance is observed at $p < 0.05$, and they recommend $r > 0.5$ should be considered a large correlation (with $r > 0.3$ classified as a medium correlation). Buckley and Doyle (2016) also used correlation analysis to report on relationships between intrinsic motivation and participation in a gamified learning scenario.

In each of the three examples above (Buckley and Doyle, 2016; Fanfarelli and McDaniel, 2017; Reid et al., 2015), hypotheses were presented and tested using a number of analytical methods. These articles provide a framework for the study at hand. None of these articles, however, describe the basis on which the surveys they used can be said to be reliable and valid. Indeed, Cohen et al. (2011) suggest that dishonest answers and/or poor response rates pose a difficulty in this respect. Assurance of anonymity may go some way to reducing dishonest responses in the

case at hand, and rate of response has already been shown to be good (the usable sample size is 37 students out of a population of 52).

3.6.4 Qualitative data analysis

The aim of the qualitative analysis is to identify underlying themes which will be considered complimentary to the literature review and the analysis of the survey data. This concept of using the qualitative to compliment the quantitative analysis is seen as a powerful way of verifying causality, and Robson (2002) reports that qualitative analysis can help identify mechanisms for such causality (p. 475). The approach being used is a mixed methods approach, which offers methodological triangulation as a means of ensuring validity and reliability to the findings (Cohen et al., 2018, p.266).

The approach taken was thematic analysis. This approach involves a process of first-order descriptive coding, second-order interpretive coding and third-order thematic analysis. This approach has been chosen as it offers a flexible method of analysis for the researcher (Braun and Clarke, 2006). One of the flexible aspects of this approach is that it can be conducted with a range of sample sizes, even as few as four (Cedervall & Åberg, 2010). Given the sample size (eight student interviewees, plus six interviews with further stakeholders), the use of thematic analysis seems appropriate. The process of thematic data analysis involves coding. Bryman (2012, pp. 576-7) offers steps to consider when coding; transcription of interviews, adding initial coding at first read-through of transcripts, read-through of transcripts again with addition of notes, review of codes, consideration of forming themes. This aligns with the approach taken for this study, which is framed around a 6-stage guide presented by Braun and Clarke (2006):

- Stage 1: familiarise yourself with the data (including transcription of verbal data)
- Stage 2: generate initial codes
- Stage 3: search for themes
- Stage 4: review themes
- Stage 5: define and name themes

- Stage 6: produce report

An alternative approach to analysing the interview transcripts would be through the use of grounded theory. However, Joffe (2012) argues that thematic analysis is more suited to smaller scale research than grounded theory, and that it is a suitable means of emphasising the subjective views of the research participants without the researcher being drawn into constructing a fictional account of the phenomena being researched. Ryan and Bernard (2000) contend that thematic analysis is differentiated from grounded theory in that the former aims to describe and explain the data without attempting to generate any novel theory to explain the findings. Cohen et al. (2018) suggest that while there is ‘no one single or correct way to analyse and present qualitative data’ (p. 643), one should abide by the ‘principle of fitness for purpose’ (p. 647). Taking the above into account, it would seem that thematic data analysis is fit for purpose for the current study.

3.7 Development of the digital open badge scheme

Following the analysis of the Phase 1 study (see section 4.2), a ‘Starter Pack’ of digital open badges was designed for implementation in the Phase 2 study. This section describes the software used to (graphically) design, develop and manage this set of digital open badges. The nature and earning mechanisms for the digital open badges in the ‘Starter Pack’ is also described in this section.

3.7.1 Software used to design and implement the digital open badge scheme

The development and implementation of the ‘Starter Pack’ required the use of a number of software tools. These were:

Designapp.io

Designapp.io is a free, web-based graphic design application. This was used to create the visual appearance of each digital open badge. The process involved setting a canvas size to suit the resolution of the digital open badge image (square, 200 by 200px) and dragging/dropping pre-formed shapes into place. Colours can be controlled and text can be added to suit. The resulting image is saved as a .png file format. The visual element of all digital open badges in the ‘Starter Pack’ was created using this application.

Open Badge Factory

The Open Badge Factory (OBF) is a web-based platform for creating and issuing digital open badges. There are other platforms available, but the OBF was chosen for several reasons. Firstly, the company is based in the European Union, and so concerns about privacy are met through GDPR protection. Secondly, the OBF has a plug-in for Moodle (the virtual learning environment used at the GMIT), and so it offers a choice of mechanisms for issuing digital open badges. Thirdly, customer support was of an excellent standard from the very beginning. Having decided to use the OBF platform, the developer of the OBF then agreed to sponsor the cost of the platform for two years, covering the period when the study was conducted.

There are two mechanisms within the OBF for issuing digital open badges. Some of the digital open badges were ‘pushed’ to the students, and others were issued when the students ‘applied’ for them. The digital open badges relating to attendance were pushed to students (i.e. a link to the badge was emailed directly to the student without any need for action on their part). The CAD Buddy badges were also pushed to students, following lecturer review of an activity on Moodle. The other digital open badges required the earners to apply for them. This involved the students proactively seeking the digital open badges by engaging in a Moodle activity which was directly linked to the OBF platform.

Open Badge Passport

The Open Badge Passport (OBP) is a web-based repository for collating digital open badges earned. This is the ‘earner-facing’ interface of the OBF. There are many options for earners when it comes to collecting, displaying and sharing the digital open badges that they have earned. The OBP was chosen as a suggested starting point for the earners but given the open nature of the digital open badges, the earners are free to move their digital open badges to other platforms if they wish. There were two considerations when utilising this repository. Firstly, an on-boarding digital open badge was created. This was developed so that the student participants had a reference point for what it was like to earn and save a digital open badge. This had the added effect of ensuring that all of the students already had an OBP account set up prior to the ‘Starter Pack’ being utilised. This leads to

the second point: the students were advised to create their OBP account using a personal email address in addition to their official student email address. This was done so that the earners will have access to their account in the future when their student email addresses have been rescinded after graduation.

Moodle

Student attendance recording and all assessment submissions are managed by Moodle for the CAD module at the GMIT. The structure of the Moodle page for the module is framed around ‘topic’ boxes, where in most cases each box referred an individual weekly tutorial. The OBF plug-in for Moodle means that digital open badges can be issued by the OBF from within the Moodle interface. There were three mechanisms by which the students could actively engage with the digital open badge issuing process. Firstly, there was a link in each topic box where a student could take part in an activity to nominate a classmate if they had been helpful to them that week. This activity required the nominator to provide a written description of the time, date and nature of the event leading to the nomination. The nominations were reviewed by the lecturer, and this formed the basis for issuing the ‘CAD Buddy’ digital open badges. The second mechanism involved creating a link to an OBF application form. This link had restricted visibility, and only students scoring 80% or above in an assessment got to see this link on Moodle. The student then had to actively engage in seeking the digital open badge by clicking that link and requesting the relevant digital open badge. All applications made were then approved by the lecturer. The final mechanism within Moodle related to the ‘level-up’ digital open badges. In the topic boxes for each of the assessments, there was a link where students could upload a second attempt. When this occurred, the submitted file was reviewed by the lecturer, and if it was to a higher standard than the original submission, the corresponding level-up digital open badge was issued to the applicant.

3.7.2 Development of the digital open badge scheme

As a result of the Phase 1 study (see section 4.2), it was clear that there is a case to include digital open badges related to both skills mastery and performance-approach. There is some indication in Phase 1 also that digital open badges that use peer issuing and digital open badges relating to attendance may be of value.

With this in mind, the ‘Starter Pack’ that was developed is shown in Figure 3.2, below. This is the set of digital open badges that was trialled in the Phase 2 study.

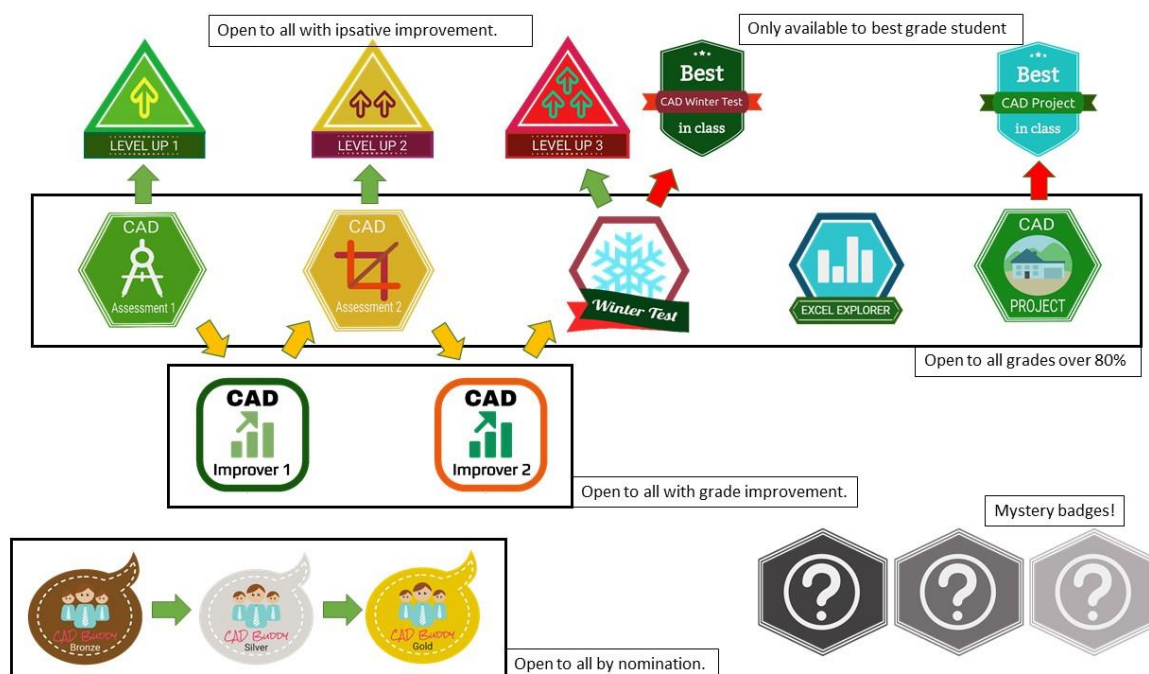


Figure 3.2 The set of digital open badges developed for implementation

There are four categories of digital open badge in the Starter Pack. These are:

- Skills mastery based (high achievement in an assessment, levelling up, improving between assessments)
- Performance based (achieving best grade in two key assessments)
- Peer based (issued via peer nomination)
- Mystery badges (description and mechanism for earning was not explained to the students in advance)

To be eligible for the ‘high achiever’ digital open badge, the student must score 80% or higher in the associated assessment. All students meeting this criterion are eligible to claim these digital open badges.

To earn the ‘level up’ digital open badge, a student must demonstrate an increase in skills mastery in an optional second attempt at any particular assessment activity (the grade for the first attempt only is counted towards overall final grade).

To be eligible for the ‘improver’ digital open badge, a student must demonstrate an improvement in grade between two consecutive assessments, even if the grade is not above 80% in either of them.

There are two key assessments in the module, these being the Winter Test and the end of year Project. The ‘best in class’ digital open badge is made available to the student scoring the highest grade in each of these two assessments.

The ‘CAD Buddy’ badges are made available to students who are peer-nominated for being helpful. In an attempt to build trust and reliability, the mechanism for nomination used was that the student doing the nominating had to submit a short description and explanation with their nomination, which was submitted via an activity on the virtual learning environment. The nomination was reviewed by the lecturer before being approved. These digital open badges are level-based, each level being linked to the number of nominations approved. A notional system of threes was used: three nominations earns the bronze, six earns the silver and nine earns the gold. The exact number for each was not explained in advance to the students, although they were made aware that the level increased with number of nominations.

‘Mystery’ badges are based on the concept of the ‘hidden’ digital open badges included in the McDaniel et al. (2012) study. In that study the results are mixed in relation to deliberately hiding the digital open badges and their earning mechanisms, but the intention was that such badges would have a positive motivational effect, and so they are included for trial in the ‘Starter Pack’ with that same intention. Three mystery digital open badges related to number of classes attended in each semester and across the whole year (100% attendance was required to be eligible). A final mystery digital open badge for ‘best mentor in class’ was developed with the employer. The employer set the criteria for earning this, and it was to be awarded to the student with the highest number of peer nominations (the employer emphasis on peer learning being in evidence here). The nature and mechanism for earning the ‘best mentor in class’ digital open badge was not explained to the students in advance.

For examples of the details contained within the digital open badges, see Appendix 11.

3.7.3 In-presentation change to the digital open badge scheme

The ‘CAD Buddy’ badge earning mechanism required review during the implementation. The concept of ‘unlocking’ digital open badges based on number of activities is found in Hamari (2017) where bronze, silver and gold level badges are made available for 2, 6 and 15 activity completions respectively. The participants Hamari (2017) study were engaged in a module which involved group discussion, sharing and online trading as a central core requirement. Such activities are not a core requirement of the CAD module, and so total number of peer actions required to obtain the top level was reduced to nine for the top, ‘gold’ CAD Buddy digital open badge. The total number of classes in the CAD module is 26 per year and based on lecturer experience it was anticipated that if peer nominations occurred in one third of those, that was likely to be the extent of that type of activity. Therefore, nine nominations seemed like a reasonable number to set for the top level. The spread of levels was then evenly split, resulting in a requirement of three nominations per digital open badge level.

During module delivery, it was clear that while peer learning was observed in the classroom, the anticipated number of nominations was over-estimated, and that it was going to take longer for students to reach three nominations to earn their first badge than expected. Therefore, to ensure the ‘CAD Buddy’ digital open badges became utilised, a change was made. Around the mid-point in the delivery, students with one nomination were awarded the ‘bronze’ level ‘CAD Buddy’ digital open badge. The intention of making this change was to ensure that peer learning was recognised by using that digital open badge. The risk of not making this change was that if no student reached three nominations, no recognition would have been given for peer learning activity. The students were aware (it was in the description of the ‘bronze’ digital open badge, see Appendix 11) that further nominations would result in earning silver and gold level badges. However, at no point were the students made aware of the exact numbers involved. The intention of this approach was to avoid nominations being made just for the sake of targeting the next level digital open badge.

On reflection, the required number of nominations originally chosen proved ambitious. In addition, splitting the levels into equal numbers of nominations (i.e. three per level) does not reflect the scale of effort required for prolonged peer

learning activities. The sliding scale of Hamari (2017) allows for early issue of digital open badges, with the higher levels requiring more effort to obtain than the lower ones. The in-presentation change made to the CAD Buddy badge earning mechanism reflects the need for, and benefit of, the sliding scale approach.

3.8 Conclusion

In Phase 1, Year 1 and Year 4 students on CAD modules participated in online surveys, reflective journals and interviews. In that Phase, lecturing staff, institute management and an employer took part in interviews. In Phase 2, Year 1 students participated in two online surveys, one at the commencement of the module (September 2017) and the second at the conclusion of the module delivery (April 2018), and in interviews held after completion of module delivery. During Phase 2, the students were eligible to earn a number of digital open badges if they met certain criteria (for example, 100% attendance, or high performance in an assessment). Given the breadth of data obtained, there is potential to investigate many aspects of the student perception of the digital open badge scheme. For example, their attitude towards digital open badges, gamification, peer assisted learning and networking. Each of these aspects can be analysed using descriptive statistics. A further purpose of the research project is to examine whether the exposure to the digital open badge scheme has any measurable effect on motivation and/or academic performance. Differences over time will be investigated using t-tests and relationships will be investigated using the Pearson correlation. Such data analysis establishes if statistically significant differences and/or relationships exist. Uncertainties and/or ambiguities arising from the quantitative data analysis were considered when developing a set of open-ended questions which were used for interviews with student participants. The institute manager and employer involved in the Phase 1 stage were interviewed a second time in Phase 2, with the aim of addressing issues arising from the student interviews and to offer overall reflections on the digital open badge scheme.

Chapter 4 Findings

4.1 Introduction

This chapter presents the findings of the data analysis based on the survey, learning journals and interviews in the Phase 1 study and surveys and interviews in the Phase 2 study. The Phase 1 study was carried out with the aim of identifying the roles that the stakeholders see for digital open badges in the civil engineering degree and with the objective of informing the design of a ‘Starter Pack’ of digital open badges, which was then implemented and investigated in the Phase 2 study. The roles identified in Phase 1 were developed further in consideration of the findings in Phase 2. The potential relationship between digital open badges and motivation has been made by Jovanovic and Devedzic (2014), although they warn us that since the use of digital open badges ‘...is in its early stages, there are numerous open questions and concerns related to their use in these roles’ (p.119). Although that paper was published in 2014, digital open badges had not been utilised at the GMIT when the current study commenced (2016), and so the questions relating to the use of digital open badges remained unanswered in this setting. For that reason, the ‘Starter Pack’ was tailored in an attempt to meet the roles of the stakeholders directly involved in this study. Additional positive impacts of digital open badges include improved attendance (Bin Rashid, 2017), improved final grades (Fanfarelli and McDaniel, 2017), and improved means of credentialing (Ahn et al., 2014). These impacts, and the roles identified in Phase 1, will be examined through the analysis of the Phase 2 study outlined in this chapter.

4.2 The Phase 1 study

The aim of the Phase 1 study is primarily to address Research Question 1:

RQ1: What role do key stakeholders - students, staff, management and employers - see for digital open badges in teaching and learning within the higher education sector?

To answer this question, several methods were used (see section 3.4.2). This section presents the findings of the survey and learning journals completed by the students, the interviews with each of the stakeholder representatives, and a

description of the overall themes found in the Phase 1 study. The findings from the Phase 1 study influenced the nature and extent of the digital open badges included in the ‘Starter Pack’. The roles identified in Phase 1 were developed further in Phase 2.

4.2.1 Survey

The student participants in the Phase 1 study (Year 1 n=45 and Year 4 n=9) took part in an online survey (Appendix 1). The aim of the survey was to obtain a profile of previous academic performance, to capture the students use of social networks, their attitude towards playing games and sharing achievements, their previous awareness of digital open badges, and to measure their motivation type and level.

The students’ previous academic performance was established by recording the CAO Entry Points of the participants. Figure 4.1, below, indicates that 25 students report less than 350 points, and can therefore be considered ‘at-risk’ of non-progression (Newell, 2015).

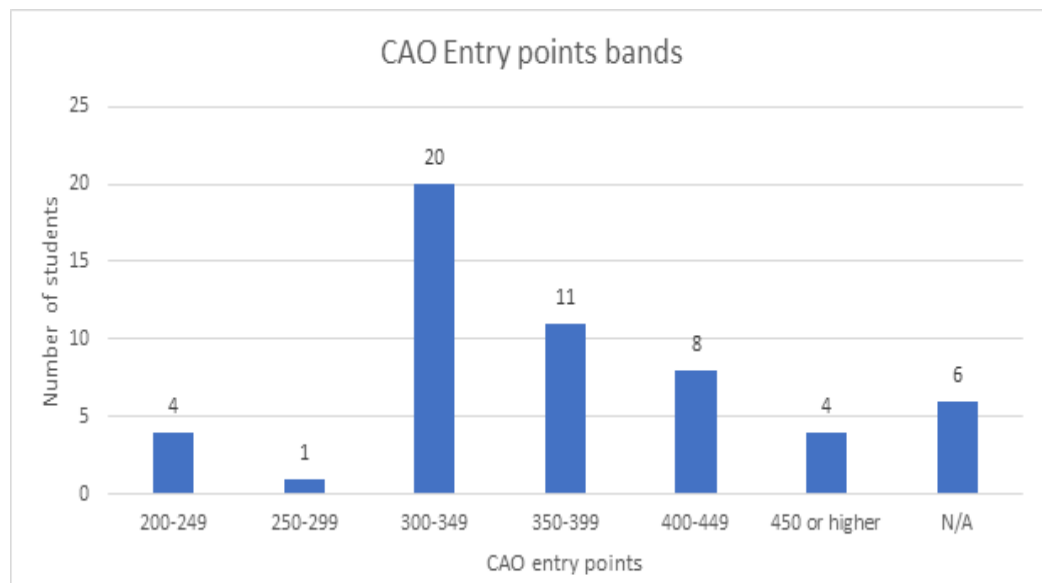


Figure 4.1 Previous academic performance of students in Phase 1

Digital open badges allow the earner to control how and where the badges get shared, with one outlet being online social/professional networks. This is important, because it offers an avenue for social interaction, which Guthrie and Davis (2003) argue is an important factor in learner engagement. Santos et al. (2013a) also argue that social interaction and sharing plays a role in creating engagement and motivation. To ascertain the level of active social network use,

the students were asked to state which platforms they actively use, see Figure 4.2 below.

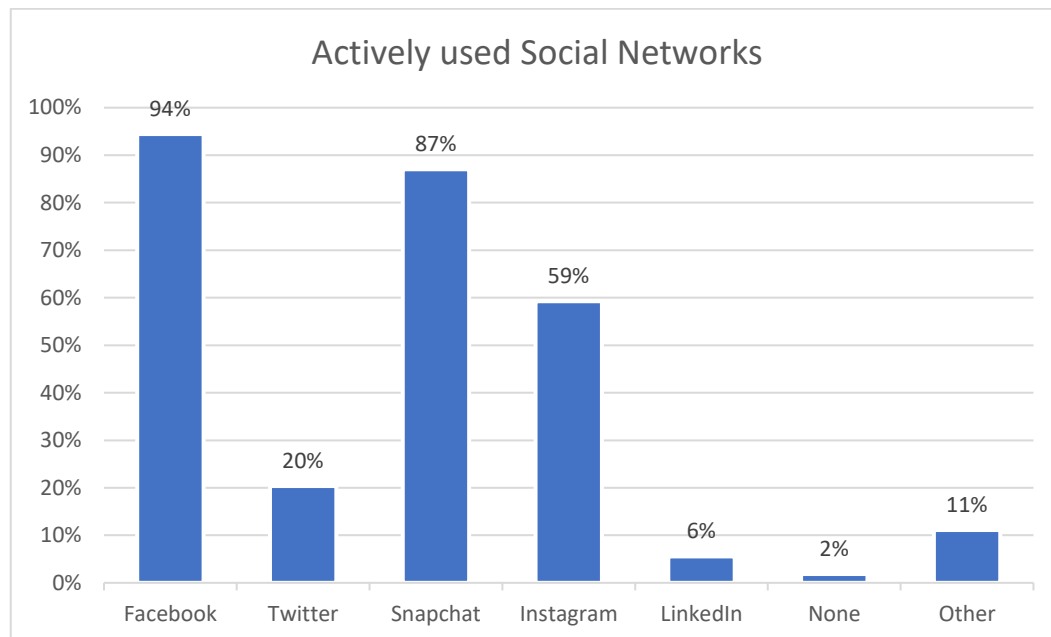


Figure 4.2 Social network platforms used by students in Phase 1

With respect to sharing digital open badge attainment, the students were asked which social network would be their first-choice platform to use. The results are shown in Figure 4.3, below. Facebook is the first choice, although there are two important differences seen between active use of social networks and use of social networks for sharing digital open badges. Firstly, more students identify LinkedIn as a destination for digital open badges than actively use that platform. This suggests that the students see a professional use for digital open badges at some point in their future. Secondly, 19% of students said that they would not share their digital open badges on any platform, despite 98% saying they actively use some form of social networking platform. This suggests that some of the students either do not see a value in sharing their digital open badge achievements, or that they do not see social networking platforms as appropriate for such sharing.

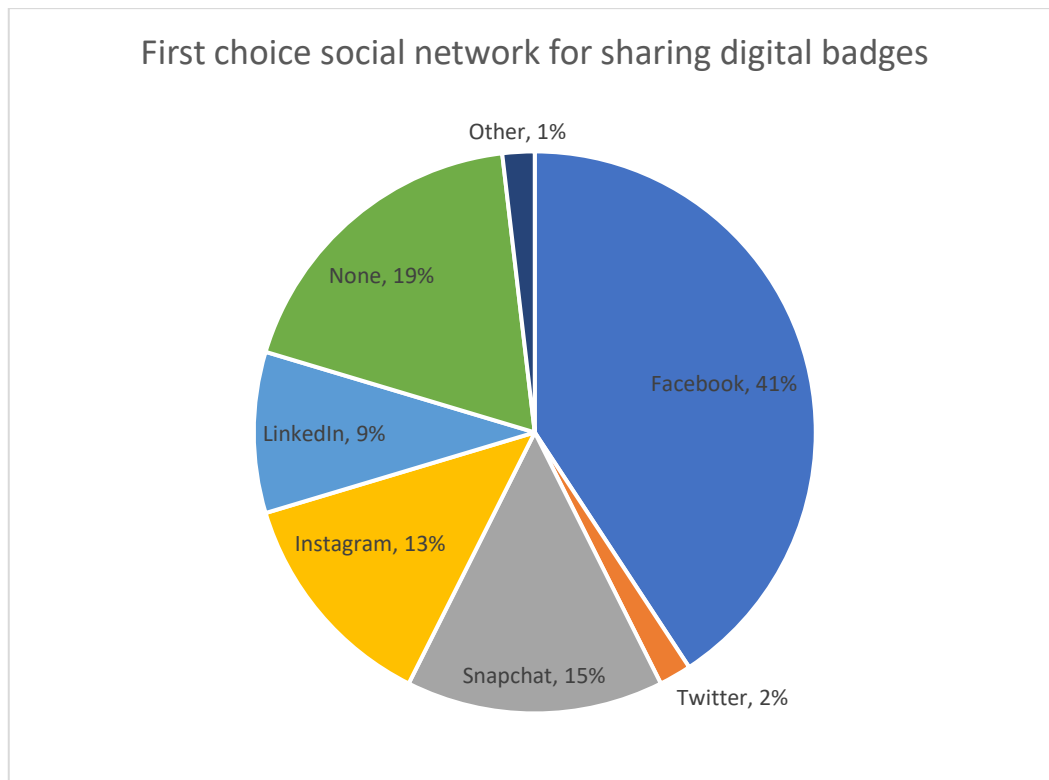


Figure 4.3 The first choice platform for sharing digital open badge achievements

The students were asked if they engage with online/console/PC games. 74% of the respondents stated that they engage in this type of game playing. Such activity would suggest a predisposition to digital open badges in the context of gamification. When asked how important it is for them to share their gaming achievements 52% said it was ‘not at all’ important, 35% said it was ‘somewhat’ important and 13% said it was ‘very’ important for them. This suggests that while most students are active game-players, sharing their achievements with others is not a priority for them.

With respect to prior awareness, 70% of the students said that they had never heard about/seen/received a digital open badge in the past. This is not surprising, given the use of digital open badges was relatively new at the time of the survey (2016) and they had not been present in a module at the GMIT up to that point.

This survey included two questions aimed at establishing the level and quality of student motivation. Table 4.1, below, summarises the response to the Intrinsic Motivation Index question, which is used to measure the level of motivation.

Table 4.1 Phase 1 Intrinsic Motivation Index question results

Question	Category	N	Phase 1 Mean	Phase 1 SD
1	Value/usefulness	54	6.259	0.935
4		54	5.574	1.143
8		54	6.463	0.719
11		54	4.926	1.211
14		54	6.815	0.892
17		54	6.222	0.861
20		54	6.259	0.805
2	Perceived choice	54	5.555	1.930
6		54	5.037	1.913
7		54	5.833	1.656
12		54	5.500	1.645
16		54	4.796	1.887
18		54	4.833	1.657
19		54	5.204	1.878
3	Interest/enjoyment	54	5.074	1.286
5		54	5.630	1.202
9		54	5.796	0.877
10		54	6.241	0.989
13		54	5.704	1.238
15		54	5.500	1.240
Valid N (listwise)		54		

Table 4.1 shows the mean and standard deviation for the responses to the IMI questions in the Phase 1 survey. The questions are based on the three categories developed by Deci and Ryan (1985), namely value/usefulness, perceived choice and interest/enjoyment. In Deci and Ryan (1985) the questions are presented in an

order so that the three categories are not easily discerned by the participant. The same order was used in the Phase 1 survey. To aid the reader, the questions are re-ordered and grouped into the three categories in Table 4.1.

Table 4.2, below, shows the overall mean and SD results for each of the three categories. The scale used ranges from 1 ('not at all true for me') to 7 ('very true for me'), and so the maximum value possible is 7.

Table 4.2 Overall mean and SD for the IMI categories in Phase 1

Category	Phase 1 Mean	Phase 1 SD
Value/usefulness	5.984	0.938
Perceived choice	5.251	1.795
Interest/enjoyment	5.657	1.139

A second measure was used to establish the quality of the motivation. This was based on Achievement Goal Theory measurement by Elliot and Church (1997). Table 4.3, below, shows the mean and standard deviation for the responses to the AGT questions in the Phase 1 survey. The questions are based on the three categories developed by Elliot and Church (1997), namely performance-approach goal, skills mastery and performance-avoidance goal. To aid the reader, the categories have been grouped and labelled in Table 4.3.

Table 4.3 Phase 1 Achievement Goal Theory question results

Question	Category	N	Pre-delivery Mean	Pre-delivery SD
1	Performance-Approach Goal	54	4.889	1.667
2		54	4.852	1.731
3		54	4.889	1.656
4		54	4.296	1.808
5		54	4.796	1.752
6		54	5.778	1.645
7	Skills Mastery	54	6.759	0.512
8		54	6.611	0.596
9		54	6.593	0.789
10		54	6.130	0.991
11		54	5.352	1.348
12		54	5.426	1.283
13	Performance-Avoidance Goal	54	4.593	1.858
14		54	4.833	1.314
15		54	4.759	1.613
16		54	5.000	1.822
17		54	2.630	1.617
18		54	2.444	1.734
Valid N (listwise)		54		

The overall mean and standard deviation for each category at pre-delivery and post-delivery stages are shown in Table 4.4, below. The scale used ranges from 1 ('not at all true for me') to 7 ('very true for me'), and so the maximum value possible is 7.

Table 4.4 Overall mean and SD for the AGT categories in Phase 1

Category	Phase 1 Mean	Phase 1 SD
Performance Approach	4.917	1.710
Skills Mastery	6.145	0.920
Performance avoidance	4.043	1.659

The skills-mastery approach is the most prevalent in the students. Elliot and Church (1997) link this approach with intrinsic motivation. Both other categories (particularly the performance-avoidance approach) are linked with extrinsic motivation. The responses here show that the student participants are more strongly intrinsically motivated than extrinsically. This supports the findings shown in Table 4.2, above, where it is also clear that the participants are tending towards intrinsic motivation. Taken together, these scores indicate that there is a relatively high level of motivation and that the type of motivation is tending towards intrinsic based on skills mastery. This suggests that the students are motivated primarily by their desire to increase their skills in the CAD module, followed by motivation through competition with others ('performance-approach'). This indicates that digital open badges focussed on 'skills mastery' may prove to be a motivational device with the participants and is the justification for the inclusion of 'improver', 'high achiever' and 'level-up' digital open badges in the 'Starter Pack'. Digital open badges in the 'Starter Pack' which relate to the 'performance-approach' (i.e. motivation to perform better than others) are the 'Best in Class' badges.

4.2.2 Learning journal

All students in Year 1 and Year 4 were invited to volunteer to keep a learning journal. In total three students (two 1st Year and one 4th Year) volunteered to do so over a three-week period (see Appendix 6). Three issues emerged from analysing the reflective journals: the students identified activities that could be associated with a digital open badge, the students recognised that desirable qualities can be linked to digital open badges, and that they have reservations with respect to the implementation of the digital open badge scheme design.

Firstly, the activities suggested were for the most part linked to academic performance. There were suggestions to badge best performance in each assessment, in each semester and/or overall for the year. Performance-based digital open badges were also identified where they could be linked to completing tasks ahead of time. An example of an activity not linked to academic performance was given by a Year 4 student: he suggested that a digital open badge could be given where a student makes a second attempt at an assessment and submits it for feedback rather than a grade. He also reported watching video tutorials outside of class time to help his understanding of the software, and suggested that such extra-curricular activity should be recognised with a digital open badge. All three students reported positively on their experience of peer-assisted learning, and suggested that helpful classmates could be nominated for a digital open badge.

Secondly, with respect to desirable qualities of a digital open badge, one student identified the potential benefit of sharing a badge with an employer, particularly if it was earned for peer-assistance. Another student reported that a digital open badge based on performance would be valuable as a motivator. This indicates that the students are seeing multiple roles for digital open badges, depending on who the intended audience is. Ultimately both use-cases are motivating, as the students view the digital open badges as something that will be of benefit to them in the future.

Thirdly, one student who expressed merit in a digital open badge based on effort (rather than assessment performance) recognised that measuring such effort may be difficult. With respect to sharing the digital open badges received, there was a reservation made about doing so on social media: the student felt it would de-value the badge if it was reduced to being measured by how many 'likes' the share received. Further reservation was made regarding issuing digital open badges for too many activities: one student said that if they are issued for 'simpler things' (the example given was for attendance), they become 'worthless'. This was a mature student who considered attendance to be a simple thing but given the variation in attendance levels on the module it is clear that not all students see it as a simple thing.

The learning journal text (Appendix 6) was included in the thematic analysis with the interview transcripts.

4.2.3 Interviews

This section summarises the main points made by each stakeholder group. While some interviewees expressed views specific to their stakeholder group, commonality was found. There were also differences in viewpoints, particularly around the use of peer-nominated digital open badges.

The students recognised the value of sharing a digital open badge within a community of practice. One student said a digital open badge is something to aim for because ‘it would be something to show again once you’d go outside college life.’ This echoes the role of digital open badges in motivating and building community seen in Knight and Casilli (2012). Students also identified the importance of involving employers in the design of the digital open badge scheme. One student said that involving employers at the design stage is ‘a good idea, because then it is going to be recognised by their standards when it goes on a CV’. This demonstrates that the students see a future purpose and value for digital open badges.

When speaking about whether an employer can trust in the quality of a digital open badge presented on a CV, the institute manager said, ‘I think they [employers] can, particularly if the employer has been involved in the development of the badge’. This reflects the value placed on the link between employability and motivation seen in Crosling et al. (2009). In addition, the institute manager advocated for the involvement of the students in the design of the digital open badges scheme. She said, ‘I think the students themselves should have a huge input into it because they kind of know...what was worthwhile to them’. This aligns well with the user-centric approach seen in Laanpere et al. (2014) and the UCD (2014) study. The institute manager identified competition and gaming as motivational devices when she said, ‘when they are gaming online, it's who can get the most points, who can do this, who can do that...it's all competition, and that motivates the student’. This observation is relevant to motivation considering that according to the survey 74% of students are engaging in gaming.

Teaching staff interviewed were mostly concerned with the quality assurance aspect of digital open badges. In particular, they recognised that the value of the digital open badge scheme would be undermined if an earner did not go on to demonstrate the qualities used to earn the badge when they are in employment. They had clear views on what constitutes the quality of a digital open badge, and the types of activity/behaviour/performance that would warrant a digital open badge. For example, one teaching colleague said that digital open badges should be ‘for students who have shown they are excelling at a certain skill’. This aligns with the concept of a digital open badge acting as a form of micro-credential.

The employer focussed on the value of a digital open badge at recruitment stage, particularly where the badge signifies candidate qualities which a traditional CV cannot communicate. Specifically, the employer expressed a preference for digital open badges awarded by peers, claiming that this would indicate a potential employee with good interpersonal skills.

There are many shared views across the stakeholders in the interview analysis. For example, all stakeholders view digital open badges as a means of increasing learner motivation. The survey data shows that the students report comparatively high levels of intrinsic motivation, and so digital open badges may be a way to expand on this. All stakeholders identify a preference for a collaborative approach to digital open badge scheme design, and perhaps this is one way to increase levels of perceived choice: one student even suggested a democratic approach to the scheme design as a means of enacting this. All stakeholders were willing to offer examples of activities/accomplishments that could be badged. The employer even offered a ‘day in the office’ as a reward for a student achieving a digital open badge linked to the skills needed in the workplace (a motivator identified by Schenke et al., 2013).

One area where mixed viewpoints exist among the stakeholders is the use of peer-nomination for digital open badges. Peer-nomination was viewed positively by both the institute manager and the employer. The institute manager contended that peer-review and peer-assessment is a thorough process, and the employer valued peer-issued digital open badges as a way to identify students that have gained the respect of their peers (perhaps indicating a trait that they would like to know about

at recruitment stage). This view aligns with O'Byrne et al. (2015), where it is contended that peer-reviewed digital open badges can help build a community of practice. Student participants expressed concern, however, that the value of digital open badges may be undermined if they were in control of issuing the digital open badges: essentially, badge inflation may occur if they are issued in an inappropriate way (i.e. too often, for meaningless achievements, and only between friends). This unwillingness to engage in peer-issuing reflects the sentiment of students seen in Santos et al. (2013a). Teaching staff also raised the concern that peer-issued digital open badges may devalue the scheme, stating that such badges could be interpreted as being of lower quality than lecturer-issued digital open badges. There is, then, differing views on peer-issuing of digital open badges which requires further investigation (conducted in Phase 2).

A similar split in participant views occurred on the topic of using a leader board. Both the employer and institute management viewed the leader board as a true reflection of the reality of competition in the workplace and contend that it is a useful and factual way to track performance. However, the student participants expressed a reservation shared by the teaching staff: the leader board may promote motivation for those near the top, but it may also demotivate those of lower ranking. This view echoes the findings of Dominguez et al. (2013). As a compromise, teaching staff and students that had negative views about the leader board suggested that it is an approach that might work if it showed rank only, and not a list of names. As an example of contradictory views within one stakeholder group, one member of teaching staff (who had raised the concern over the potential for the leader board to demotivate) also stated that it could be a useful tool for initiating reflection for the students. Despite the views expressed, none of the interviewees raised the issue of privacy in relation to a leader board, although consideration with respect to GDPR would be required if a leader board was to be used. User identity and data is to be protected, particularly where the potential for profiling/discrimination is to be avoided (Wachter, 2018). For that reason, those considering the implementation of a leader board would have to be mindful of both the ethics relating to the potential for demotivation and the legal exposure if privacy was compromised.

Where challenges were presented by the participants, potential solutions were also given. For example, the question of how employers can trust digital open badges was raised (reflecting a similar issue found in Gibson et al., 2016). To address this potential risk, the stakeholders offered several approaches: trust can be built by verification that peer-issued digital open badges are being vetted by teaching staff, by involving employers in the design of the scheme from the start, and by educating employers about the role of digital open badges on the degree. The importance of educating all stakeholders about digital open badges is apparent, considering the low level of prior awareness among students and the suggested requirement to ensure employers understand exactly what a digital open badge represents. Involving employers in the design stage would seem a sensible approach, not only to develop trust, but also because their input could inform the description of skills/attributes that they desire in a graduate. This approach would offer a way of enacting the observation of Hassan and Bhat (2014) when they argue that learner motivation can be increased where the learner sees a link between the learning material and employability.

4.2.4 Outcomes

Phase 1 interview transcripts from all participants (students, lecturing staff, institute manager and employer) and the learning journals were subjected to an iterative approach of descriptive coding, interpretive coding and thematic analysis. The following four findings emerged from the data:

- There is a transformative effect of digital open badges
- Digital open badges have a role as a symbol in community of practice
- There are desirable qualities to be designed into the digital open badges
- There are challenges to consider in designing a digital open badge scheme

Codes were created according to their contribution to answering the Research Question 1: “What role do key stakeholders - students, staff, management and employers - see for digital open badges in teaching and learning within the higher education sector?”

The codes created were:

- “Com” where phrases related to community of practice.

- “Qual” where phrases related to desirable qualities.
- “Cha” where phrases related to potential challenges to the use of digital open badges

The theme of “transformative effect” was divided into sub-themes and associated codes as follows:

- “Tr-s” where phrases related to the transformative effect on students.
- “Tr-t” where phrases related to the transformative effect on teaching practice.
- “Tr-I” where phrases related to the transformative effect on the institute.
- “Tr-e” where phrases related to the transformative effect on the employer.

‘Transformative’ here means that as a result of thematic analysis of the reflective journals and interview transcripts, it became clear that all stakeholders saw a role for digital open badges in changing their experience of teaching and learning. In some cases, digital open badges offer a completely new way to influence the learning experience (for example, by offering a means of awarding recognition for actions that are not catered for in the current system, such as teamwork). In other cases, digital open badges can be used to re-shape current practices (for example to enhance feedback), or to offer a formal link between the learning environment and employment.

Figure 4.4, below, summarises the transformative roles that digital open badges play for each of the stakeholder groups, as identified in Phase 1.

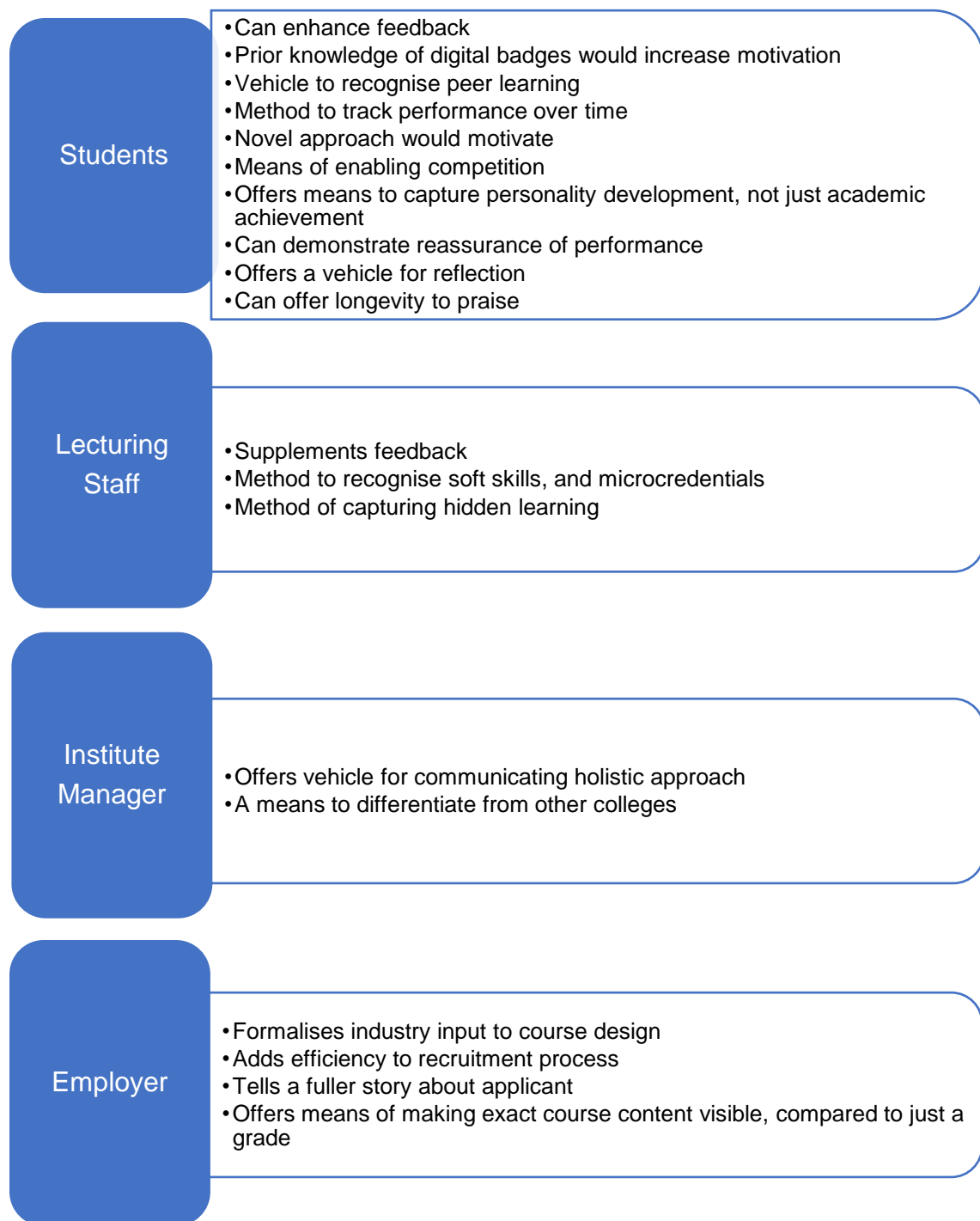


Figure 4.4 The transformative roles of digital open badges for stakeholder groups, identified in Phase 1

Digital open badges play roles as symbols within a community of practice. This summarised in Figure 4.5, below.

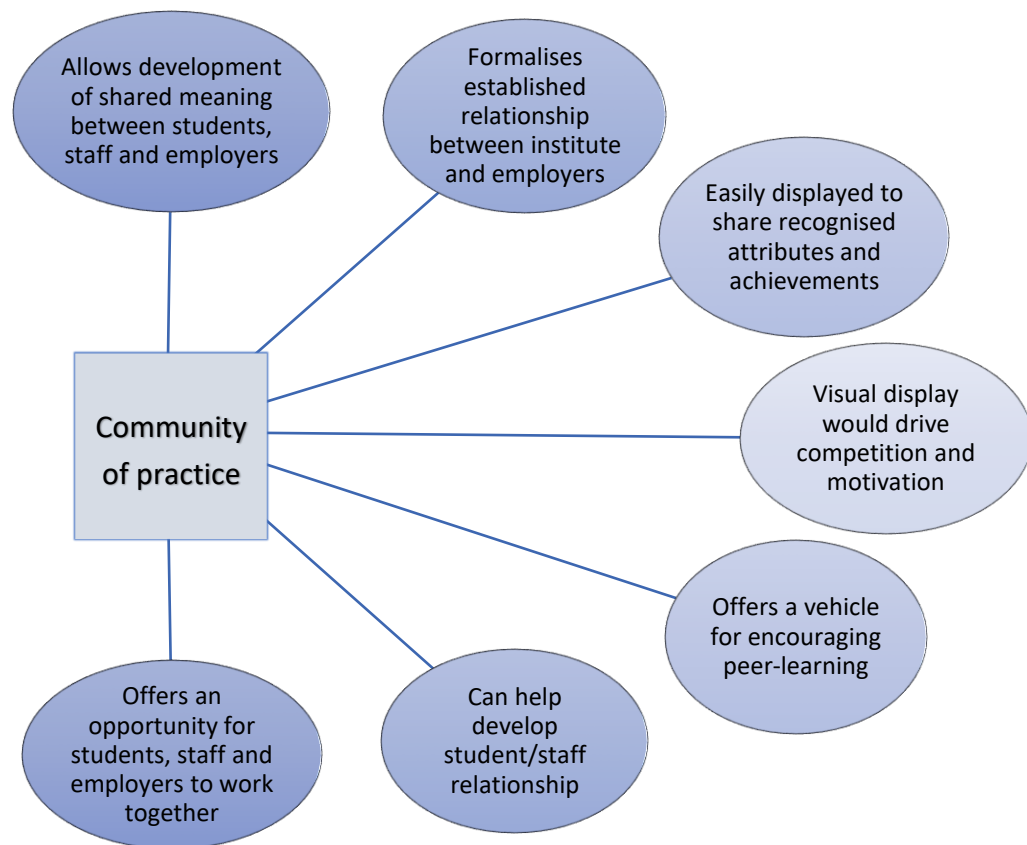


Figure 4.5 The roles of digital open badges within a community of practice, identified in Phase 1

Figure 4.6, below, summaries the desirable qualities to be associated with the design of a digital open badge scheme.

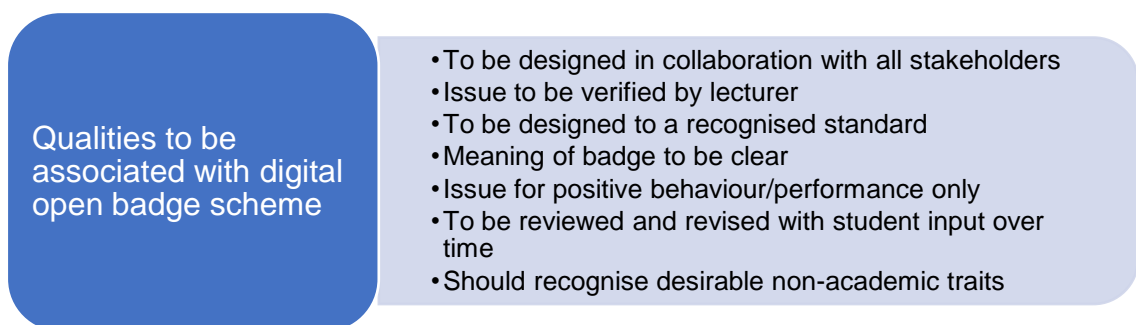


Figure 4.6 The desirable qualities to be reflected in the design of a digital open badge scheme, identified in Phase 1

There were some reservations made by the stakeholders, which formed the final theme of challenges to be considered when designing a digital open badge scheme. These are summarised in Figure 4.7, below.

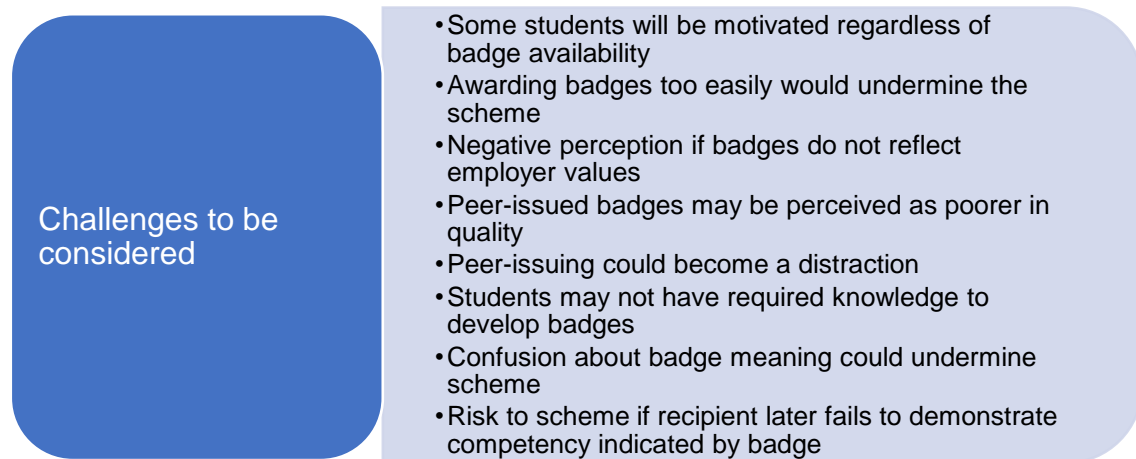


Figure 4.7 The challenges to be considered in the design of a digital open badge scheme, identified in Phase 1

4.2.5 How Phase 1 influenced the ‘Starter Pack’

An essential output from Phase 1 was the development of the suite of digital open badges (i.e. the ‘Starter Pack’) for investigation in Phase 2. The survey data reveals a relatively strong interest in gaming (74% of students indicate they engage in online/console/PC gaming). This suggests a predisposition towards gamification: an approach enabled by the use of digital open badges.

Based on the survey analysis, it is clear that the students are highly intrinsically motivated, which is primarily driven by their desire for skills mastery. To capitalize on this approach, the following digital open badges were included:

- High Achiever (obtaining 80% or greater in assessments)
- Level-up (for demonstrating increased skills mastery in second, non-graded, attempts at assessments)

The secondary driver for intrinsic motivation found in the survey data is performance-goal. This relates to motivation due to competition, either with self or others. The following digital open badges reflect this quality:

- Best in Class (for ‘Winter Test’ and ‘Project’ assessments)
- CAD Improver (for demonstrating improved grades between consecutive assessments)

It is clear from the interviews that the stakeholders have identified multiple roles for digital open badges. Many of these are reflected in the four types of digital open badges above. For example, micro-credentials in the form of badges for high achievement, enhancement of feedback in the form of the CAD Improver badges and enabler of competition in the form of the best in class badges. However, additional roles were identified which do not relate to assessment-based earning criteria. For example, all stakeholders expressed views on the values of peer learning. This type of learning activity can go unnoticed and/or unrewarded, and so the following digital open badge (earned through peer nomination) was included:

- CAD Buddy

The full suite of digital open badges is outlined in section 3.7.2, and detailed descriptions for each of the badges is shown in Appendix 11.

4.3 The Phase 2 study

The focus of the Phase 2 study is on Research Questions 2 and 3:

RQ 2: What processes and practices enable participatory digital open badge use by students and teachers?

RQ 3: How do digital open badges impact on learning, learner motivation and engagement and institutional teaching processes?

In addition, the roles for digital open badges identified in Phase 1 are developed further in Phase 2. In this respect, both phases contribute to Research Question 1:

RQ1: What role do key stakeholders - students, staff, management and employers - see for digital open badges in teaching and learning within the higher education sector?

In Phase 2, Year 1 students on the Computer Aided Design module participated in two online surveys, one at the commencement of the module (September 2017) and the second at the conclusion of the module delivery (April 2018). In the intervening time, the students were eligible to earn a number of digital open badges if they met certain criteria (for example, 100% attendance, high performance in an assessment and/or through peer nomination). At the conclusion of the module delivery, four students volunteered to participate in semi-structured interviews. Following this, interviews took place with an institute manager and an employer.

Research Questions 2 and 3 are addressed by analysing the Phase 2 survey and interview data. There is no clear distinction as to whether one method can be applied to one Research Question: the data from the survey and the interviews are integral to answering both Research Questions. The surveys were conducted prior to the interviews. The initial analysis of the survey data informed the development of the interview questions. For that reason, the results of the survey are presented first in this section, followed by the findings of the interviews.

4.4 Quantitative results of the Phase 2 study

The Phase 2 surveys primarily focus on investigating previous academic performance of the students and the impact that the use of digital open badges has on the learners, which relates to Research Question 3. To assess the influence of previous academic performance (secondary level) on performance and interaction with the digital open badge scheme on the module, the following question is investigated:

- Is there a relationship between CAO entry points and number of digital open badges earned, and academic performance in the module?

As a means of investigating the impact of the digital badge scheme on the learners, the following sub-questions are investigated by the data analysis:

- Is there a relationship between the number of digital open badges earned and academic performance in the module?
- Is there a relationship between attendance and number of digital open badges earned and/or academic performance in the module?
- What change (if any) is there in learner motivation over the course of the academic year?

In another study of digital open badges with a similar sample size, Fanfarelli and McDaniel (2017) recommend that correlations where $r > 0.3$ are considered ‘medium’ and those with $r > 0.5$ are considered ‘large’. This defines how the correlations are interpreted in this thesis. Questions relating to digital open badge awareness, gamification, and perceptions towards digital open badges will also be analysed in this section.

4.4.1 Data sources

The data sources for the Phase 2 study were the pre- and post-delivery surveys (plus manually entered information for each participant), followed by interviews with students, an employer and institute management. The aim of the pre-delivery survey (September 2017) was to gather data from the students on aspects such as the type and strength of their motivation, their perceptions and prior knowledge of digital open badges, their attitudes towards gaming and their academic achievements (CAO entry points) at commencement of the module. The aim of the post-delivery survey (April 2018) was to gather data from the students relating to the type and strength of their motivation, and their attitude towards digital open badges having been exposed to them over the course of the academic year. All students had opportunities to earn digital open badges over the year. In both the pre- and post-delivery surveys, there were two questions relating to motivation. There is a distinction between the level and the type of motivation, and so the questions presented in the survey capture both aspects.

In addition to the data collected through the surveys, further information was included in the data set in the SPSS file. This data originates from lecturer records and the digital open badge platform reports. This was manually entered, and

includes the following information for each student (codes used for each variable shown in brackets):

- Final module grade (FG)
- Semester 1 attendance (S1A)
- Semester 2 attendance (S2A)
- Overall attendance for the year (OA)
- Number of digital open badges earned (BE)
- Number of digital open badges claimed (BC)

The final grade is based on a culmination of scores awarded for continuous assessment tasks throughout the year. Attendance is based on weekly roll call taken at the start of each class. Data on the number of digital open badges earned and claimed are obtained from the Open Badge Factory platform used to distribute the digital open badges.

4.4.2 Considering CAO Entry Points

CAO entry points play a role in student success, as they indicate the level of academic preparedness for higher education. Students entering the Civil Engineering programme with lower CAO points are at risk of non-progression (p.68). It is important to understand the relationship between entry points and module success; this can be used in discussions with institute management when entry point levels are being considered in the future. This is relevant to this thesis because it helps identify whether there are ‘at-risk’ students in the class cohort whose motivation levels may need nurturing.

The question being investigated in this section is:

- Is there a relationship between CAO entry points and number of digital open badges earned, and academic performance in the module?

Table 4.6, below, shows the frequency distribution across the 37 respondents. The mean band is the 350-399 band, and 73% of the students are in or above that band. Nine students are in or below the 300-349 band and can be considered at risk of

non-progression. The N/A refers to a student entering as a ‘mature student’ (over 23 years of age) that did not require a declaration of points for the CAO system.

Table 4.6 CAO Entry Points for student participants

CAO Entry points	Frequency	Percent
Valid 200-249	2	5.4
250-299	2	5.4
300-349	5	13.5
350-399	15	40.5
400-449	8	21.6
>450	4	10.8
N/A	1	2.7
Total	37	100.0

Table 4.7, below, shows a crosstabulation of CAO Entry Points and Final Grade achieved. As suggested in the comment regarding Table 4.6, Table 4.7 shows that of the 4 students entering at or below the minimum requirement, 3 have failed the module.

Table 4.7 CAO Entry Point and Final Grade crosstabulation

		Final Grade							Total
		80-89%	70-79%	60-69%	50-59%	40-49%	35-39%	<35%	
CAO Entry Points	200-249	0	0	0	0	0	0	2	2
	250-299	0	0	0	1	0	1	0	2
	300-349	0	0	2	1	2	0	0	5
	350-399	1	4	5	2	3	0	0	15
	400-449	1	1	4	1	1	0	0	8
	>450	0	1	1	0	1	1	0	4
	N/A	0	0	1	0	0	0	0	1
Total		2	6	13	5	7	2	2	37

The result of a Pearson Correlation between CAO Entry Points and Final Grades is shown in Table 4.8, below. The student entering as a ‘mature’ applicant has been removed from this correlation, as he did not possess a CAO Entry Point value. Therefore $n=36$ students were surveyed about their previous academic performance ($M=350-399$ CAO points, $SD=1.25$) and this was investigated with respect to their final grade ($M= 58.4$, $SD=14.77$). A Pearson’s r data analysis revealed a medium positive correlation, $r=.442$. This suggests that students reporting higher CAO entry points also obtain a higher final grade.

Table 4.8 Correlation between CAO Entry Point and Final Grades

		CAO Entry Points	Final Grade
CAO Entry Points	Pearson Correlation	1	.442**
	Sig. (2-tailed)		.007
	N	36	36

** . Correlation is significant at the 0.01 level (2-tailed).

The 37 students in the sample earned a total of 120 digital open badges. This includes the ‘on-boarding’ badge which they each received for creating an Open Badge Factory account. That digital open badge does not relate to CAD module activities and is removed from the tests in this section. There is, then, a total of 83 module-related digital open badges earned by the 37 students. Table 4.9, below, shows a crosstabulation of CAO Entry Points and number of digital open badges earned.

Table 4.9 CAO Entry Point and number of Badges Earned crosstabulation

	Digital open badges earned (no.)								Total number of earners
	0	1	2	3	4	5	6	7	
CAO 200-Entry Points 249	2	0	0	0	0	0	0	0	2
250-299	1	0	0	1	0	0	0	0	2
300-349	1	3	0	0	1	0	0	0	5
350-399	2	3	3	3	2	1	0	1	15
400-449	0	2	1	2	2	0	1	0	8
>450	1	1	1	0	1	0	0	0	4
N/A	0	0	0	0	1	0	0	0	1
Total	7	9	5	6	7	1	1	1	37

Fewer students were eligible for the larger number of digital open badges. Only 3 students were eligible for 5 or more digital open badges. Average number of digital open badges earned is 2 per student.

Table 4.10 Correlation between CAO Entry Point and number of Badges Earned

		CAO Entry Points	Digital open badges earned
CAO Entry Points	Pearson Correlation	1	.227
	Sig. (2-tailed)		.102
	N	36	36

The result of a Pearson Correlation between CAO Entry Points and number of badges earned is shown in Table 4.10, above. The ‘mature’ applicant who did not possess a CAO Entry Point value is removed from this correlation. Therefore, $n=36$ students were surveyed about their previous academic performance (*Mean band*=350-399 CAO points, $SD=1.25$) and this was investigated with respect to their number of badges earned ($M=2.1$, $SD=1.77$). A Pearson’s r data analysis revealed a low correlation, $r=.277$. This suggests that there is not a strong relationship between previous academic performance and the number of badges earned. This is supported given that $p=.102$, which suggests that the relationship is not significant.

Summary of findings: There is evidence of a weak, non-significant relationship between CAO entry points and the number of digital open badges earned. There is a medium relationship between CAO entry points and academic performance, where those entering the programme with higher CAO entry points also achieve a higher final grade.

4.4.3 Considering number of badges earned

It is important to understand whether students earning more digital open badges obtain different outcomes to those earning fewer (p.83). This is relevant to Research Question 3, as it investigates one aspect of how digital open badges can impact on the learner experience; whether earning digital open badges is linked to better academic performance.

The question being investigated in this section is:

- Is there a relationship between the number of digital open badges earned and academic performance in the module?

A total of 120 digital open badges were earned by the 37 students. 37 of those digital open badges were the ‘on-boarding’ badge, earned for creating an Open Badge Passport account at the beginning of Phase 2. Therefore the 37 students earned 83 digital open badges for activities directly related to the CAD module. Of those, 25 were awarded for high academic performance in assessments (i.e. achieving a grade of 80% or greater and/or best in class grade in specific assessments). Because of the direct link between those digital open badges and high grades, they are removed from the investigation in this section as they are not independent variables. This leaves a total of 58 digital open badges awarded for activities not related to assessment grades, which form the basis of the investigation in this section. Table 4.11, below, shows a crosstabulation of final grade and number of digital open badges earned for non-academic criteria. This shows that in general students with a higher number of digital open badges also have a higher final grade.

Table 4.11. Crosstabulation between Final Grade and number of digital open badges earned for non-assessment criteria

		Number of non-assessment digital open badges earned						
		None	1	2	3	4	5	6
Final Grade	80-89%	0	0	0	1	0	0	1
	70-79%	1	3	0	2	0	0	0
	60-69%	1	4	3	3	2	0	0
	50-59%	1	3	0	1	0	0	0
	40-49%	2	4	0	1	0	0	0
	35-39%	2	0	0	0	0	0	0
	<35%	2	0	0	0	0	0	0
Total			7	10	5	6	6	1

Table 4.12 Correlation between Final grade and number of non-assessment based digital open badges earned

		Final grade	Non-assessment Digital open badges earned
Final grade	Pearson Correlation	1	.507
	Sig. (2-tailed)		.001
	N	37	37

The result of a Pearson Correlation between Final grade and number of non-assessment based digital open badges is shown in Table 4.12, above. 37 student final grades ($M=58.5$, $SD=14.78$) were investigated with respect to their number of badges earned for non-assessment based criteria ($M= 1.56$, $SD=1.44$). A Pearson's r data analysis revealed a large correlation, $r=.507$. This suggests that there is a large relationship between final grade performance and the number of badges earned for non-assessment based criteria.

A regression analysis was carried out on this relationship, Table 4.13. A scatter plot is shown in Figure 4.8, below, which indicates the relationship is linear.

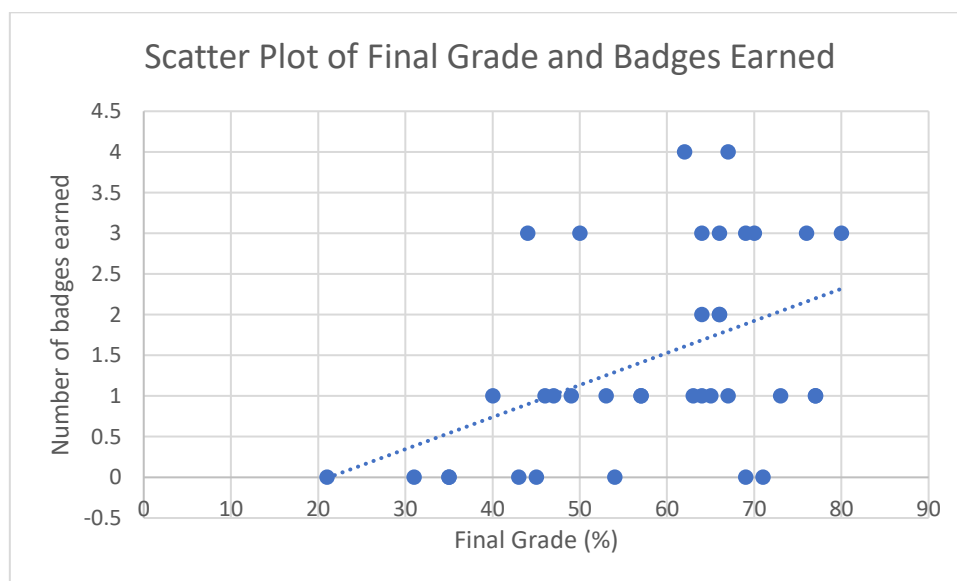


Figure 4.8 Scatter plot of final grade and number of badges earned

Table 4.13 Regression analysis between Final grade and number of digital open badges earned for non-assessment based criteria

ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	2019.077	1	2019.077	12.096	.001 ^b
Residual	5842.112	35	166.917		
Total	7861.189	36			

a. Dependent Variable: Final grade

b. Predictors: (Constant), Non-assessment badges earned

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	50.330	3.158		15.936	.000
Badges Earned	5.186	1.491	.507	3.478	.001

a. Dependent Variable: Final grade

The model summary is shown in Table 4.14, below:

Table 4.14 Model summary of Final grade and number of digital open badges earned for non-assessment based criteria

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.507 ^a	.257	.236	12.9197

a. Predictors: (Constant), Badges Earned

The adjusted R Square value of .236 is relatively low, suggesting that the number of digital open badges earned for non-assessment based criteria is not a reliable predictor of final grade.

Summary of findings: There is a large correlation between the number of digital open badges earned and academic performance. Students earning more digital

open badges tend to achieve a higher final grade. This is expected if all digital open badges in the scheme are related to academic activities, however not all digital open badges are awarded on academic criteria, and the relationship tested considers badges earned for non-graded activities only. The adjusted R Square value is relatively low, suggesting that obtaining digital open badges is not a reliable predictor of final grade, and that an increase in digital open badge acquisition is not the sole cause of higher academic performance.

4.4.4 Considering attendance level

Attendance is a measure of student engagement, with higher levels of attendance being desirable (Romer, 1993). This section investigates the relationship between attendance level and academic performance in the form of final grade. This is relevant to Research Question 3 because if a relationship is demonstrated, communicated and encouraged (through the issuing of digital open badges), it will have an impact on student behaviour.

The question being investigated in this section is:

- Is there a relationship between attendance and number of digital open badges earned and/or academic performance in the module?

The overall (across the whole academic year) attendance per student on the CAD module is shown in Figure 4.9, below. The range is between 55% and 100%, with 8 students achieving 100% attendance. Average attendance across the 37 participants is 87%.

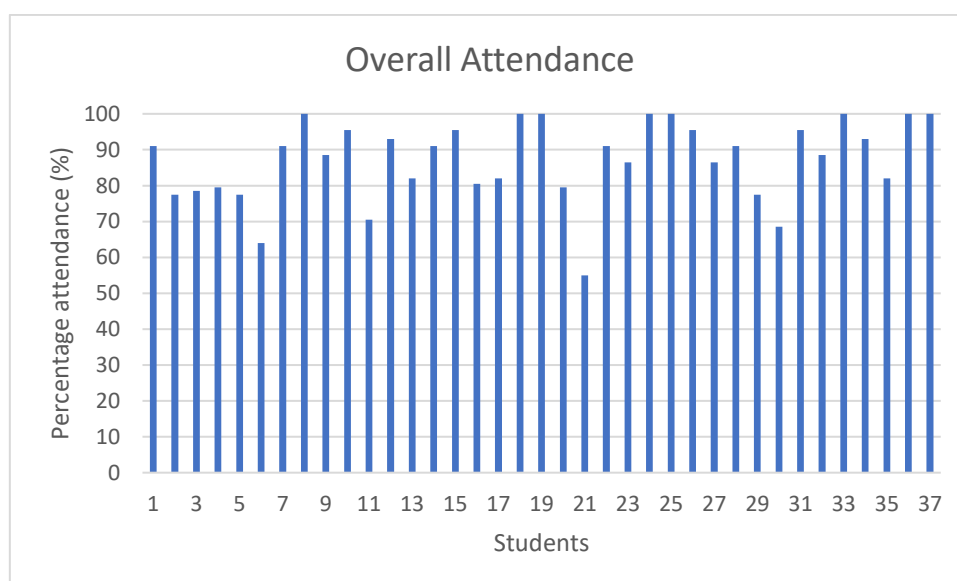


Figure 4.9 The overall attendance rate for the CAD module

The first relationship being considered is that between attendance level and final grade (FG). The attendance level included here is the overall attendance for the academic year (OA).

Table 4.15. Correlation between Final Grade and Overall Attendance

	OA	FG
OA Pearson Correlation	1	.524**
Sig. (2-tailed)		.001
N	37	37

** . Correlation is significant at the 0.01 level (2-tailed).

The result of a Pearson Correlation between Overall Attendance and Final Grades is shown in Table 4.15, above. The attendance of 37 students ($M=87.23$, $SD=11.22$) was investigated with respect to their Final Grade ($M= 58.46$, $SD=14.78$). A Pearson's r data analysis revealed a large correlation, $r=.524$. This suggests that there is a large relationship between attendance and academic performance, where those students attending to a higher level also obtain higher final grades.

Table 4.16 Correlation between digital open badges earned and Overall Attendance

	OA	BE
OA Pearson Correlation	1	.157
Sig. (2-tailed)		.355
N	37	37

The result of a Pearson Correlation between Overall Attendance and number of badges earned (BE) is shown in Table 4.16, above. For this test, badges earned as a result of 100% attendance were removed from the data set, to ensure

independent variables only were used. The attendance of 37 students ($M=87.23$, $SD=11.22$) was investigated with respect to the total number of digital open badges earned for achievements other than 100% attendance ($M=2.14$, $SD=1.35$). A Pearson's r data analysis revealed a small correlation, $r=.157$, which is not statistically significant ($p>0.05$). This suggests that there is a no relationship between attendance and number of digital open badges earned.

Summary of findings: There is no relationship between attendance level and number of digital open badges earned. There is a large relationship between attendance level and final grade. Generally, those students with higher attendance levels also achieve higher final grades.

4.4.5 Motivation using the Intrinsic Motivation Index

The Intrinsic Motivation Index (IMI) is an appropriate way to measure the strength of motivation according to Hegarty (2011). The index consists of several questions, and in this thesis has been used in two surveys in Phase 2. The first was conducted at the commencement of the CAD module, prior to the use of digital open badges, and the second was conducted at the end of the academic year during which the digital open badges were used. Understanding the level of motivation is important to Research Question 3, as the digital open badge scheme aims to increase student motivation.

The question being investigated in this section is:

- What change (if any) is there in learner motivation over the course of the academic year?

Table 4.17, below, shows the mean and standard deviation for the responses to the IMI questions in the pre-delivery survey, and the mean, standard deviation and difference in mean for the same questions in the post-delivery survey. The questions are based on the three categories developed by Deci and Ryan (1985), namely value/usefulness, perceived choice and interest/enjoyment. In Deci and Ryan (1985) the questions are presented in an order so that the three categories are not easily discerned by the participant. The same order was used in the Phase 2 surveys. To aid the reader, the questions are re-ordered and grouped into the three categories in Table 4.17.

Table 4.17 Descriptive statistics for IMI question responses in Phase 2

Question	Category	N	Pre-delivery Mean	Pre-delivery SD	Post-delivery Mean	Post-delivery SD	Delta Mean
1	Value/usefulness	37	6.486	.6921	6.703	.5708	+0.217
4		37	5.270	1.1217	5.946	.8802	+0.676
8		37	6.541	.6496	6.486	.6921	-0.055
11		37	4.324	1.3955	3.973	1.4041	-0.351
14		37	6.243	.8302	6.162	1.0932	-0.081
17		37	6.297	.7403	6.378	.7208	+0.081
20		37	6.162	.8979	6.162	.9578	0
2	Perceived choice	37	3.108	1.8971	3.784	1.7342	+0.676
6		37	3.514	2.0899	3.892	1.6293	+0.378
7		37	5.081	1.6563	4.946	1.7472	-0.135
12		37	3.811	1.9125	3.973	1.5721	+0.162
16		37	3.243	1.8167	3.541	1.6765	+0.298
18		37	3.892	1.7761	4.297	1.7459	+0.405
19		37	4.405	1.7711	4.189	1.5958	-0.216
3	Interest/enjoyment	37	6.000	.7454	6.162	.6877	+0.162
5		37	5.730	.9617	5.919	1.0898	+0.178
9		37	5.919	.8293	6.162	.7270	+0.243
10		37	6.027	.9276	6.108	.9940	+0.081
13		37	5.757	.9547	5.946	.8147	+0.189
15		37	5.622	.9531	5.811	.9380	+0.189
Valid N (listwise)		37					

Some survey questions show relatively large increases in mean values at post-delivery stage compared to pre-delivery. For example, Q2 asks the student if they believed they had a choice about doing the module. This shows an increase in the

post-delivery scenario of 0.676. Likewise, Q18 asks if the student felt they had a choice while doing the module. This shows an increase of 0.405 in the post-delivery scenario. These increases were tested for statistical significance (paired sample t-test) using the null hypothesis ‘there is no change in motivation level after delivery of the module’ and neither was shown to be significant. Q2 had a t-value of -1.633 and a p of 0.111 ($p > 0.05$ and so the null hypothesis is not rejected). Q18 had a t-value of -1.054 and a p of 0.299 ($p > 0.05$ and so the null hypothesis is not rejected). The finding of the increase is still of interest, though, as the module is a mandatory one and so the students really had no choice but to do the module. So, what was it within the module, while they were doing it, that they felt they had choices about? Could it be the option to go for certain digital open badges over others, or to take part in optional second attempts at assessments, or to decide how to engage with peer-nominations? Self-determination theory tells us that students feel more motivated when they have choices, so it would be interesting to know exactly what choices they felt they had. This could result in identifying areas for further digital open badge development.

The overall mean and standard deviation for each category at pre-delivery and post-delivery stages are shown in Table 4.18, below.

Table 4.18 Overall mean and SD for the IMI categories in Phase 2

Category	Pre-delivery Mean	Pre-delivery SD	Post-delivery Mean	Post-delivery SD
Value/usefulness	5.903	1.195	5.973	1.259
Perceived choice	3.865	1.937	4.088	1.706
Interest/enjoyment	5.842	0.901	6.018	0.887

All three categories using IMI show an increase in motivation levels. The mean for each category was compared in the pre- and post-delivery surveys to check for statistically significant differences. This was carried out using a paired sample two-tailed t-test. The results are shown in Table 4.19, below.

Table 4.19 Difference in overall means for the IMI categories in Phase 2

	Value/usefulness	Perceived choice	Interest/enjoyment
Change in Mean	+0.070	+0.223	+0.176
t-value	-0.577	-1.885	-8.062
P	0.5848	0.1080	0.0005

The null hypothesis being tested is ‘there is no change in motivation level after delivery of the module’. From Table 4.19 above, the null hypothesis cannot be rejected for the categories of value/usefulness and perceived choice. This means the increase in motivation for these categories is not significant.

However, there was a significant increase in the interest/enjoyment category after the implementation of digital open badges (M=6.018, SD=0.887) compared to before the implementation (M=5.842, SD=0.901); $t(5)=-8.06$, $p=.0005$. A Cronbach’s α test was conducted on the responses in the interest/enjoyment category at both the pre-and post-delivery stages, which returned high levels of reliability (.847 and .846 respectively).

Therefore, null hypothesis is rejected for the category of interest/enjoyment. This means that the students are reporting a significant increase in motivation level due to being more interested in and/or enjoying the CAD module by the end of the academic year. This is a very important finding of the case study, as it directly addresses Research Question 3:

RQ 3: How do digital open badges impact on learning, learner motivation and engagement and institutional teaching processes?

Rejecting the null hypothesis for the interest/enjoyment category indicates that motivation levels have risen significantly for the students over the period of time when the digital open badge scheme was implemented.

4.4.6 Motivation using Achievement Goal Theory

The Achievement Goal Theory (AGT) survey questions are a suitable way to measure the type of motivation (intrinsic or extrinsic) according to Hegarty (2011). Understanding this is important for the design of the digital open badge scheme. For example, students with high levels of intrinsic motivation are likely

to engage with digital open badges that reward skills mastery (e.g. ‘level-up’ type). Students motivated by performance (comparison with others) are more likely to aim to obtain ‘best in class’ type digital open badges.

The question being investigated in this section is:

- What change (if any) is there in learner motivation over the course of the academic year?

Table 4.20 Descriptive statistics for AGT question responses in Phase 2

Question	Category	N	Pre-delivery Mean	Pre-delivery SD	Post-delivery Mean	Post-delivery SD	Delta Mean
1	Performance-Approach Goal	37	4.189	1.7770	4.351	1.7194	+0.162
2		37	4.486	1.8046	4.216	1.5835	-0.270
3		37	4.811	1.5427	4.811	1.4689	0
4		37	3.838	1.6917	4.351	1.6024	+0.513
5		37	4.324	1.5995	4.216	1.5659	-0.108
6		37	5.946	1.2006	5.568	1.3026	-0.378
7	Skills Mastery	37	6.703	.6610	6.541	.6496	-0.162
8		37	6.568	.6472	6.297	.8777	-0.271
9		37	6.730	.5602	6.676	.4746	-0.054
10		37	6.000	1.1055	5.703	1.3095	-0.297
11		37	5.405	1.3008	5.405	1.1170	0
12		37	5.108	1.0484	5.459	.8365	+0.351
13	Performance-Avoidance Goal	37	4.378	1.7377	3.946	1.6658	-0.432
14		37	4.189	1.6640	3.838	1.5901	-0.351
15		37	4.189	1.7294	4.568	1.4821	+0.379
16		37	5.486	1.4457	5.378	1.4211	-0.108
17		37	2.892	1.5596	3.324	1.7647	+0.432
18		37	2.757	1.7063	2.405	1.4426	-0.352
Valid N (listwise)		37					

Table 4.20, above, shows the mean and standard deviation for the responses to the AGT questions in the pre-delivery survey, and the mean, standard deviation and difference in mean for the same questions in the post-delivery survey. The questions are based on the three categories developed by Elliot and Church (1997), namely performance-approach goal, skills mastery and performance-avoidance goal. To aid the reader, the categories have been grouped and labelled in Table 4.20. The overall mean and standard deviation for each category at pre-delivery and post-delivery stages are shown in Table 4.21, below.

Table 4.21 Overall mean and SD for the AGT categories in Phase 2

Category	Pre-delivery Mean	Pre-delivery SD	Post-delivery Mean	Post-delivery SD
Performance approach	4.599	1.732	4.586	1.603
Skills Mastery	6.086	1.120	6.014	1.044
Performance avoidance	3.982	1.873	3.910	1.808

All three categories show little change. The changes in means between the pre-delivery and post-delivery responses to the questions were checked using a paired sample two-tailed t-test. The results of this are shown in Table 4.22 below, where no statistically significant change is found.

Table 4.22 Difference in overall means for the AGT categories in Phase 2

	Performance approach	Skills Mastery	Performance avoidance
Change in Mean	-0.013	-0.072	-0.072
t-value	0.1030	0.7421	0.4575
P	0.9220	0.4914	0.6665

One explanation for this is that motivation levels on entry were high to begin with. Individual questions do show greater mean differences in the pre- and post-delivery than the overall means show. For example, Q4 shows an increase of 0.513 after module delivery. This question relates to students wishing to out-perform their peers. A paired sample two-tailed t-test was carried out on the mean

responses to this question to test the null hypothesis ‘there is no change in motivation level after delivery of the module’. This returned a t-value of -2.0065 and P value of 0.052 . This p is >0.05 and so the null hypothesis is not rejected, although it is relatively close to being so. The increase in this case can be interpreted to suggest that motivation increased over the module delivery as a result of competition between the students.

Summary of findings relating to motivation: The strength of motivation, measured using the Intrinsic Motivation Index, shows an increase over the academic year, significantly in the category of interest/enjoyment. The type of motivation, measured using Achievement Goal Theory did not change significantly over the academic year. Students reported a relatively high tendency towards intrinsic motivation throughout.

4.4.7 Attitude towards playing games

Table 4.23 shows a set of statements presented in the pre-delivery survey. The purpose of these statements was to ascertain the attitude that the students have towards playing online/console/mobile games, in the context that digital open badges are viewed as a gamification device. In Bin Rashid (2017) the contention is that the use of gamification can increase interest, motivation and attendance levels in students. Responses below show a strong pre-disposition to aspects of gaming which is interpreted to signal a strong pre-disposition to the use of digital open badges within the CAD module.

Table 4.23 Attitude toward playing online/console/mobile games

	<i>Agree</i> %	<i>Somewhat</i> <i>agree</i> %	<i>Neither</i> <i>agree/disagree</i> %	<i>Disagree</i> %	<i>Not</i> <i>Applicable</i> %
1. Monitoring my performance on a leader board is important to me	16.2	29.7	21.6	21.6	10.8
2. It is motivating to receive in-game achievements or trophies	48.6	37.8	2.7	2.7	8.1
3. I compare my progress to other players	43.2	18.9	13.5	18.9	5.4
4. I compare my performance scores to other players	48.6	18.9	13.5	13.5	5.4
5. I am not interested in how well other players are doing	8.1	29.7	29.7	27	5.4
6. I like single player games	32.4	37.8	10.8	10.8	8.1
7. Maintaining a position I've earned is important to me	48.6	32.4	8.1	2.7	8.1
8. I talk to about or share my achievements with others	10.8	37.8	18.9	21.6	10.8
9. It is important that I can see my progress as I play	37.8	45.9	5.4	2.7	8.1
10. Earning upgrades and power-ups is important to me	40.5	29.7	13.5	8.1	8.1
11. Moving up levels gives me a sense of progress	51.4	37.8	5.4	0	5.4

Table 4.23 shows mixed feelings towards the use of a leader board, reflecting what was seen in the literature review (Dominguez et al., 2013). A combined “agree” and “somewhat agree” response rate of 45.9% suggests that most students do not favour a leader board.

There is strong evidence to support the view that in-game achievements or trophies are viewed as motivational (86.4% combined “agree” and “somewhat agree” response rate). This suggests that most students would be motivated by digital open badges (when interpreted to represent achievements and trophies).

Even though the leader board is not favoured by a majority, most students do compare their progress against that of other players (62.1% agree or somewhat agree). Similarly, 67.5% agree or somewhat agree that they compare their scores against other players. This means that while they may not be in favour of displaying their own scores on a leader board, they do still want to compare their performance against others: comparisons between players is important in establishing the students own view of their performance. This is supported when we see that only 37.8% agree or somewhat agree that they are not interested in how well other players are doing.

Most students prefer single player games (70.2% agree or somewhat agree). This tells us that while they are interested in comparing their performance with others, they do not necessarily want to compete directly against others. When students see that they are performing comparatively well, they have a desire to hold onto that status. 81% agree or somewhat agree that maintaining such a position is important to them.

What is less clear, though, is the desire to share this experience with others. Less than half the students (48.6% combined agree or somewhat agree) said that they talk about their achievements with others. This suggests that while the achievements and comparisons are important to the students, they are internalised and for personal interest only.

The importance of seeing progress is clear when we see that most students (83.7%) agree or somewhat agree that monitoring and visibility of progress is important. This is an aspect where digital open badges are useful. One example of how digital open badges are useful in this context is where they are used to indicate ipsative improvements. There is strong evidence that such a use-case would be meaningful for the students, as 70.2% agree or somewhat agree that earning upgrades and power-ups is important to them, and 89.2% agree or somewhat agree that moving up levels gives them a sense of progress.

Overall there is strong evidence to suggest that the students are well disposed to game playing and the mechanics around game playing. This suggests that they are also well disposed towards digital open badges, if such badges are considered a gamification device. The number of 'not applicable' responses in Table 4.23

refers to students who answered in a previous survey question that they rarely or never played console/online/mobile games.

4.4.8 Attitude towards digital open badges (pre-delivery stage)

Nine statements and an open-ended question relating to impressions about digital open badges were presented at the pre-delivery stage (see Appendix 7, Question 8). The purpose of these was to gather information about how the students felt about digital open badges having just been introduced to them via a short video which was shown immediately prior to the survey being conducted. Two of these statements and the open-ended question are relevant to ask prior to the implementation, before the students began earning the digital open badges, but are not relevant after the delivery of the module as they refer to previous experience. However, seven of the statements were modified (change of tense) and used in the post-delivery survey also, with the intention of capturing changes in attitude over the course of the academic year. These seven statements are discussed in section 4.4.10. The remaining two statements and open-ended question are discussed below.

Table 4.24 Previous knowledge/experience with digital open badges

	<i>Agree</i> %	<i>Disagree</i> %	<i>Don't know</i> %
This is the first time I have heard about digital open badges	91.9	8.1	0
I have received digital open badges previously	8.1	78.4	13.5

The responses in Table 4.24 show that almost all (91.9%) students heard about digital open badges for the first time in the video they watched prior to taking the survey. It might be safe to say that the 8.1% of students stating that they previously received a digital open badge are the same students who said they had previously heard of digital open badges in the preceding question. The open-ended question asked in the pre-delivery survey was: *“I have some ideas for what a digital badge should be given for (please add comment below to explain):”* Eight students (out of 37 respondents) provided answers. These are shown in Table 4.25, below. These responses show that even though most of the students had only just heard about digital open badges, some were in a position to identify multiple uses for them.

Table 4.25 Suggestions for what digital open badges should be given for

<p><i>“should also be given to weaker and mid level student for confidence boost”</i></p> <p><i>“finishing assignments”</i></p> <p><i>“performace and quality”</i></p> <p><i>“doing something to a high quality”</i></p> <p><i>“hard work and attendance”</i></p> <p><i>“something a student did very well but is not being shown on CV or Degree”</i></p> <p><i>“quality of work produced”</i></p> <p><i>“I think that the preson who is the most improved throughout the month or year should get one, this would push everyone to try and improve”</i></p>

4.4.9 Attitude towards digital open badges (post-delivery stage)

Twenty statements were presented at the post-delivery stage, aimed at gathering data about the attitude of students towards digital open badges having been exposed to them for one academic year (see Appendix 8, Question 4). Seven of these statements had counterparts that were presented at the pre-delivery stage survey, and these are discussed in section 4.4.10. The remaining thirteen statements are presented in Table 4.26, below.

Most students (62.2%) disagree that the lecturer should be the only source of issuing digital open badges. This means that having experienced the digital open badge scheme, the students can see a role for themselves as issuers, through the peer nomination mechanism.

In the section relating to attitude towards playing games (Table 4.23), 48.6% agreed or somewhat agreed that they talked about their achievements with others. In Table 4.26, we see that 59.5% agreed that they discussed the digital open badges with their classmates. This indicates an increase in social activity around the scheme, with the digital open badges being discussed to a larger extent than the students had anticipated at the pre-delivery stage.

Table 4.26 Attitudes towards digital open badges at post-delivery stage

	<i>Agree %</i>	<i>Disagree %</i>	<i>Don't know %</i>
I think that only the lecturer should issue digital open badges	27	62.2	10.8
I discussed the badges with my classmates	59.5	32.4	8.1
There were too few badges offered on the module	18.9	54.1	27
The badges were aesthetically pleasing	70.3	8.1	21.6
I displayed my badges on my social media/networks	2.7	86.5	10.8
I liked knowing how to earn badges in advance	75.7	13.5	10.8
I liked finding out about the mystery badges as a surprise	54.1	27	18.9
I would have preferred to know about how to earn all the badges in advance	45.9	27	27
I think badges should be available in other modules	75.7	8.1	16.2
I would choose a course that offers badges over one that does not	13.5	56.8	11
Badges linked to assessments are more valuable than badges linked to non-academic things like attendance and being a helpful classmate	37.8	45.9	16.2
I obtained all the badges that I set out to earn	10.8	54.1	13
Overall, the digital open badges increased my motivation on the CAD module	54.1	35.1	10.8

With 18.9% agreeing that there were not enough digital open badges on the scheme, it is clear that there is little desire for adding more badges in a future implementation. Most students (70.3%) agreed that the digital open badges were aesthetically pleasing: this indicates that the appearance of the badges does not need refinement in a future implementation.

Although a total of 120 digital open badges were earned by the sample of 37 students throughout the module delivery, only one student shared their digital open badges on social media/networks. This may be because the other students did not see any value in sharing on those particular platforms, but that they did share them elsewhere (for example, on a CV). We have seen that the students discuss digital open badges within their class, but it is clear that they do not see a need to share the badges more widely on social media/networks.

Most students (75.7%) agreed that they liked knowing about how to earn the digital open badges in advance. We see that just over half (54.1%) agreed that they liked learning about the 'Mystery Badges' as a surprise. There were mixed views when asked if they would have preferred to know about how to earn all of the digital open badges in advance (45.9% agreed that would have preferred to

know in advance). On balance, it seems there is an overall preference for knowing about the digital open badges in advance, but there is room for ‘Mystery Badges’ too. This is something to consider for future implementations.

There is a positive sentiment towards widening digital open badge availability (75.7% agree that digital open badges should be offered in other modules), which is encouraging. Based on this positive attitude, the response when asked about choosing one course instead of another due to digital open badge availability could be said to be different to expectation. This may mean that while the students have a positive attitude towards the digital open badges, the badges by themselves do not provide enough of an attraction to choose one course over another.

In relation to the value of digital open badges, there are mixed views on whether badges are more valuable when associated with assessments or non-academic activities. 37.8% of the students agreed that assessment-based digital open badges are more valuable, and 45.9% disagreed with this view. This shows that the students have a narrow preference for digital open badges issued for non-academic activities. Examples of digital open badges in this category are ones for attendance and for mentoring. There is no clear majority of views, however, which indicates that the students value both academic and non-academic criteria almost equally.

Only 10.8% of the students agreed that they obtained all of the digital open badges that they set out to earn. One interpretation of this is that the students had set a high level of performance expectancy, which would yield a high number of digital open badges, and they simply fell short of the targets they set for themselves. Another interpretation is that they were aiming for the “best in class” digital open badges, which only one student was eligible to earn.

In relation to motivation being increased on the module due to the digital open badges, 54% agreed that the badges increased their motivation (35.1% disagreed). While this is over half the class, and is encouraging, there is clearly scope to improve the scheme to increase this number. Given the general satisfaction with aspects such as the number of digital open badges and their appearance, improving the scheme should focus on the implementation rather than adding/changing the digital open badges on offer.

4.4.10 Changes in attitude towards digital open badges over the academic year

Seven statements relating to attitudes towards digital open badges were presented at both the pre-delivery and post-delivery stages. These are shown in Table 4.27, below.

Table 4.27 Changes in attitudes to digital open badges from pre- to post-delivery stage

Pre-delivery statements	<i>Agree %</i>	<i>Disagree %</i>	<i>Don't know %</i>	Post-delivery statements	<i>Agree %</i>	<i>Disagree %</i>	<i>Don't know %</i>
I would like to earn some digital badges	78.4	0	21.6	I liked to earn digital badges	86.5	5.4	8.1
I think digital badges would enhance my experience of the CAD module	67.6	2.7	29.7	I think digital badges enhanced my experience of the CAD module	43.2	29.7	27
I would like to be able issue digital badges to my classmates	27	32.4	40.5	I liked being able to nominate a classmate for a digital badge	67.6	8.1	24.3
I would like my classmates to issue digital badges to me	32.4	32.4	35.1	I would like my classmates to issue digital badges to me	59.5	21.6	18.9
I think digital badges should only be given to the best student in the class	18.9	70.3	10.8	I think digital badges should only be given to the best student in the class	8.1	89.2	2.7
I think anyone that completes a task to certain level of proficiency (even if they are not the best in class) should get a digital badge	73	13.5	13.5	I think anyone that completes a task to certain level of proficiency (even if they are not the best in class) should get a digital badge	83.8	5.4	10.8
Digital badges should be available for more than just assessment feedback	59.5	8.1	32.4	Digital badges should be available for more than just assessment feedback	81.1	2.7	16.2

Prior to delivery, 78.4% of students said that they would like to earn some digital open badges. This rose to 86.5% by the end of the academic year. This is encouraging, as experiencing the digital open badges had the effect of making more students like them than had expected to. Interestingly, no student disagreed with this statement at the pre-delivery stage, but 2 students (5.4%) reporting not liking earning the digital open badges at the end of the academic year. This shows that while there is an overall positive view of digital open badges, not everyone shared that view. This could be because the reality of the first-hand experience of digital open badges did not match the expectations of those students. There was a high expectancy (67.5% agreed and 2.7% disagreed) at the pre-delivery stage that the digital open badges would enhance the experience of the module. This expectation did not manifest, however, as 43.2% agreed that the digital open badges had enhanced their experience and 29.7% disagreed with this at the post-delivery stage. This represents a 24.3% drop in agreement that the digital open badges enhanced the module. This shows that the students were open to the implementation, but that it did not work out as expected for them. There were more students in agreement that the digital open badges enhanced their experience than not, but it is not definitive, suggesting that the digital open badges are not for everyone.

At the pre-delivery stage, the students expressed mixed views on peer-issuing digital open badges (27% agreed and 32.4% disagreed that they would like to issue badges to classmates). This may be due to the students having a preference (or higher perceived trust level?) for digital open badges issued by non-peers. In the case of this module, that would mean the lecturer. However, at the post-delivery stage, there was a considerable change in attitude. Having experienced the digital open badge scheme, 67.6% now agreed (increase of 40.6%) that they liked being able to nominate a classmate for a digital open badge, and 8.1% disagreed. This aligns with 27% agreeing that only the lecturer should issue digital open badges, when asked about this at post-delivery stage (see Table 4.26, above). On the other side of this process, where the students were asked about receiving a digital open badge from their classmates, at the pre-delivery stage the class was almost exactly evenly split between agree, disagree and don't know. At the post-delivery stage, we see a considerable change in attitude, where most

(59.5%, up 27.1% compared to pre-delivery) students agree that they would like their classmates to issue digital open badges to them. Something has happened over the course of delivery of the scheme to instigate this change. Either the value that they have on peer-issued digital open badges has risen, or by being active participants in the issuing mechanism, the students are more in favour of peer-issuing than they expected to be, or both.

At the pre-delivery stage, most students (70.3%) believed that digital open badges should not only be available to the best student in the class. This shows a preference for digital open badges being more accessible than being limited to the single best academically performing student in a given task. This preference is reinforced at the post-delivery stage, where the number increased to 89.2% (increase of 18.9%) believing that digital open badges should not just be for the best student in class. This indicates that the students value a more inclusive scheme where digital open badges are available to a wider number of participants. This view is strengthened where we see that at the pre-delivery stage 73% of the students agreed that anyone reaching certain proficiency in a task (even if they are not the best in class) should get a digital open badge, and agreement with this rose to 83.8% at post-delivery stage.

When asked about the role of digital open badges, at the pre-delivery stage 59.5% agreed that the badges should be available for more than just assessment feedback (8.1% disagreed). This shows that even at that point, most students could see that the digital open badges have a value beyond supplementing grades and association with academic activities. At the post-delivery stage, this view is strengthened, with 81.1% agreeing (21.6% increase) that the digital open badges should be available for more than just assessment feedback (2.7% disagreed). This is interpreted to mean that having experienced the implementation of the digital open badge scheme, the students see greater value in the role of badges that recognise aspects of the module that are not already recognised via a grade. In other words, the students have a preference for non-assessment related digital open badges, such as those for attendance and mentoring.

4.4.11 Further attitudes towards digital open badges (post-delivery)

In addition to the statements shown in Table 4.27, the students were presented with four open-ended questions in the post-delivery survey. Provision of an answer was optional. These questions and the responses are shown Table 4.28, below.

Table 4.28 Responses to open-ended questions at post-delivery stage

Please state which was your most favourite badge (even if it is one you did not earn yourself)	30 responses. 100% Attendance (8) CAD Buddy Badge (7) Improver badge (7) High Achiever (3) Best in Class (3) Level Up (1) N/A (1)
Please state which was your least favourite badge (even if it is one you did not earn yourself)	22 responses N/A, Don't know (6) Best in Class (4) CAD Buddy Badge (3) High Achiever (2) Level Up (2) 100% Attendance (2) Improver badge (2) None (1)
If there was a badge that you really wanted to get, but didn't, which one was it?	24 responses Best in Class (10) N/A, Don't know (4) High Achiever (4) 100% Attendance (3) CAD Buddy Badge (1) Improver badge (1) None (1)

If you have any ideas for what a digital open badge should be given for, please state these here:	17 responses Don't know, none, N/A (6) Most improved over the year (4) Creative thinking/innovation (2) Meeting deadlines (1) Bronze/silver/gold for assessments (1) Effort (1) Asking questions in class (1) Attitude with assignments (1)
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30 students provided a response to state their favourite digital open badge, and half of the those stated that their favourite digital open badges were ones not related to the academic activities of the CAD module. The digital open badge for 100% Attendance was the most favourite one, followed by the 'CAD Buddy' badge. This corresponds with the narrow preference for digital open badges available for non-academic activities shown in Table 4.26. The digital open badges for showing improvement between assessments are ranked as the most favoured academic-related badges. Fewer students provided a response when asked what was their least favourite digital open badge (22). The 'Best in Class' digital open badges ranked as the least favourite type. This could be because those digital open badges were only available to one recipient, and so there was a resentment that they were not obtained. This view is supported in the responses to the next question, where we see that the 'Best in Class' digital open badges are clearly considered to be desirable (10 out of 24 respondents identified those badges as the ones they really wanted to get). Having experienced the digital open badges scheme throughout the year, 11 of the students provided suggestions for aspects of the module which they think should have a badge. 6 of these suggestions relate to assessment activities (most improved over the year, meeting deadlines, levels for assessment performance) and are considered to be variations on types of digital open badges already in the 'Starter Pack'. 5 of the suggestions would require new digital open badges to be developed to cover 'creative thinking', 'effort', 'asking questions in class' and 'attitude with assessments', although it is not clear exactly how these suggestions could be put into practice.

4.5 Qualitative findings of the Phase 2 study

This section presents the responses to the interview questions, and interpretations of their meaning. This is presented firstly as a summary of the responses to each of the ten student interview questions, followed by a thematic analysis of those interviews. Key similarities and differences between the interviewee responses will be highlighted. Four students took part in the interview phase of the Phase 2 study. The students are presented here numerically in the order in which they were interviewed. As background information, the students' performance and digital open badge collection record in the CAD module is shown in Table 4.29, below. Student 1 achieved a final grade that is marginally higher than the class average of 56%, and so he can be considered to represent the average student. Students 2 and 3 achieved well above average grades, with Student 2 achieving the highest grade in the class. Student 4 did not pass the module, and his grade of 24% represents the lower demographic in the class in terms of academic achievement. This student did not progress to Year 2 and was employed on a construction site at the time of interview. He contends that his experience since exiting higher education has made him more mature, and his intention is to return to begin the Civil Engineering programme in the GMIT again.

It should be noted that there was an "on-boarding" digital open badge which all four students claimed, but that is left out of the table below as that digital open badge was not directly related to module activity. The function of that digital open badge was to ensure the students created an Open Badge Passport account, and to allow them experience the process of earning and claiming a digital open badge. This process was carried out immediately after the pre-delivery survey was completed, and the resulting digital open badge did not represent an activity or behaviour related to the module itself.

Table 4.29 Profile of student interviewees

Student number	Final Grade (%)	Attendance (%)	No. of Badges eligible for	No. of Badges claimed	Badge(s) claimed
1	66	100	4	1	100% Attendance All Year
2	80	100	8	7	CAD Assessment 2 High Achiever CAD Improver 1 100% Attendance Semester 1 100% Attendance Semester 2 100% Attendance All Year CAD Buddy (Bronze) Best Mentor in Class
3	77	91	2	1	CAD Improver 1
4	24	68	0	0	(none)

4.5.1 Responses to the interview questions.

The ten questions used for the Phase 2 student interview are presented in this section, with an outline of the responses given by the students. Key similarities and differences are identified in this section.

- Student interview Question 1. What particular type of badge do you have a preference for? Why?

All four student participants expressed a preference for more than one type of digital open badge. Table 4.30, below, shows the preferred digital open badges identified.

Table 4.30 Preferred digital open badge type

Student 1	Student 2	Student 3	Student 4
Level-up badge	Improver badge	CAD Buddy badge	Level-up badge
CAD Buddy badge	CAD Buddy badge	Improver badge	Improver badge

As shown in Table 4.30, there are three digital open badges that are reported to be the most preferred. These are presented in the order mentioned by each student. Of these, two are related to assessment activities: the ‘improver’ digital open badge is made available to any student demonstrating an increase in grade between two consecutive assessments, and the ‘Level-up’ digital open badge is available for any student choosing to make a second (non-graded) attempt at an assessment, where the standard of their work is higher than the original (graded) submission. Student 2 described the ‘improver’ digital open badge as a way of showing that if you work hard, you can get a better grade: ‘They’re really showing...from your first test that you didn’t do so well, that you’re working hard and.... you’re improving to your second one, it shows you that you can get more in them.’ Student 4 made the same point and added that the ‘improver’ digital open badge also results in boosting confidence. The second digital open badge identified is the ‘level-up’ one. Student 1 sees this digital open badge as proof of self-belief in ability: ‘with the leveling up badges, you can always say well I did level up like, I did do better...I knew I could do better and shows that you did do better.’ The third digital open badge preferred was the ‘CAD Buddy’ badge. Student 2 said that the ‘CAD Buddy’ badge is an incentive to help classmates and would be a good digital open badge to show prospective employers as a means of sending a positive message about yourself. Student 3 said that the ‘CAD Buddy’ digital open badge shows that you are a good communicator, and that badges linked to assessment performance (‘Level-up’ and ‘Improver’ badges) would motivate you to do better in tests.

- Student interview Question 2. Would you want to earn any of these badges and why?

This question seeks to investigate why the students would want to earn the digital open badges. All four students said that they would want to earn some of the digital open badges available on the module. The three digital open badges identified in the responses to student interview question 1 also arose in answers to this question. Some further comments in the responses, however, reveal why the students would want to earn the different digital open badge types. Commonality exists in some cases, where in answering interview question 2 the ‘CAD Buddy’ digital open badges are seen by all four students as desirable in order to

communicate a positive message about the earner when included on a CV.

Student 4 goes further, to say that he would get a feeling of enjoyment from the peer recognition that a CAD Buddy digital open badge would represent, saying that this would provide a boost to his own self-belief. Although Student 4 expresses a clear reason for his interest in earning the CAD Buddy digital open badge, he did not go on to earn it. The nature of the 'CAD Buddy' badge is that it requires an actor to be proficient in the technical skills in CAD as a pre-requisite to peer learning. Student 4 did not demonstrate such proficiency. Differences in viewpoints were also seen. Students 2, 3 and 4 expressed an opinion that the 'Level-up' digital open badge would send a positive message to an employer, showing that the recipient is a fast learner and is determined to improve on previous work.

'maybe if an exam went bad for you, you mightn't be happy with the results you got, so you took that exam again and you improved on it, it shows an employer that you're determined, the determination to not just be happy for second best, you want to improve on everything you do.'

(Student 2)

Student 1 expressed a contrary view that the 'Level-up' digital open badge would send out a negative message about the recipient: namely, that they were able to do better at the second attempt but that they may not be able to perform well under pressure.

'Well, I suppose to kind of show that when push came to shove you didn't do great, but then when the stress was kind of over and wasn't as much stress on you, that you did better. It mightn't show that you're great under stress or under time limit.'

(Student 1)

He made the point that the 'Level-up' digital open badge would help to show yourself that you are capable of doing better, but that he would not show it to prospective employers. This suggests that students can control the impact of digital open badge awards.

- Student interview Question 3. Was there a badge that you really wanted to get, but didn't? Which ones? Were there any badges that you were not interested in? Why?

Student 3 and Student 4 each said they wanted the ‘CAD Buddy’ digital open badge, as a means to demonstrate good communication skills to others and to boost confidence by getting peer-recognition. Student 4 associated earning a ‘CAD Buddy’ digital open badge with enjoyment: ‘it’s one for me, personally, I think I’d like to earn because, you know, I’d get that feeling of enjoyment from helping people out.’ Student 1 responded to say he really wanted either of the ‘Best in Class’ digital open badges, as that would show others that the earner stands out from the rest of the class. He said that this is important to him, to see that he is ranked highly, and that it provided motivation as it gave him something to work for. In spite of claiming this motivated him, Student 1 did not obtain the best grade in the class and did not earn this digital open badge. Student 3 said he wanted the ‘Best Project in Class’ digital open badge to go with the ‘CAD Buddy’ digital open badge he had already earned. He said that having both digital open badges would show others that he has strong technical skills as well as team-playing abilities. When asked if there were any digital open badges they were not interested in, Students 1, 2 and 3 replied to say they would want to get everything that was available. Student 3 said the badges were a good incentive, but that access to them (in terms of user interface) could have been easier. By contrast, Student 4 said that he was not interested in either of the ‘best in class’ digital open badges, as he wanted to do the best he could for himself and did not want to put himself under pressure to be better than everyone else: ‘I wouldn’t put myself down just because I didn’t get the best in class... I wouldn’t feel under pressure to have to be as good as somebody else in that kind of way.’ This shows that students are making choices about how they engage and participate in the digital open badge scheme.

- Student interview Question 4. Did you claim all of the badges that you were eligible for? Why/why not?

Student 1 and Student 2 reported claiming all digital open badges they were eligible for, with Student 2 elaborating on this to say his motivation for doing so was to build a portfolio to show off his accomplishments: ‘...to build up the portfolio, really, to show that I had improved.’ Student 3 was unsure if he claimed all of the digital open badges but said that he believed he would have taken any badge he was eligible for. Student 4 is in an unusual position in that he was not

eligible to claim any digital open badges over the course of the delivery of the CAD module. This was due to his academic performance and attendance not being at the level to qualify for a digital open badge, nor was he nominated for one. He acknowledged that had he been eligible to claim any of the digital open badges, he would have done so, saying that digital open badges received for improving in assessments would be good motivation for him. He also said that a combination of the ‘improver’ digital open badges with the ‘CAD Buddy’ digital open badge would help you stand out to prospective employers, as it would show that you are able to push yourself and help others too.

- Student interview Question 5. Did the badges motivate you in our studies?

Students 1, 2 and 3 were definite in their position on this, namely that the digital open badges did motivate them to try harder in the module: ‘when you see that you can get this if you put your work in, it’ll motivate you to actually put the work in’ (Student 1) and ‘if there is a badge there for a high achiever, you want to strive to get that’ (Student 2). Student 4 said that he forgot about the digital open badges at times, but that he was motivated to try harder to get them when he saw his classmates getting them. At times like this, he said the digital open badges helped increase his effort on the module. Factors other than motivation must have pertained for this student, as despite claiming the digital open badges motivated him at times, he ultimately did not pass the module. Student 2 reported that after he received his first digital open badge, he wanted to get more of them and so he put more work into preparing for subsequent tests.

‘it was really after I got the first badge I was thinking "I want to get another one of these"... So coming up to the next exam, you were inclined to put in a couple of hours beforehand....you were there because you knew that coming down the line, there could be a potential of receiving a badge.’ (Student 2)

He also said that in the lead up to the submission of the Project element of the module, he put an extra effort into that, with the aim of earning the ‘Best Project in Class’ digital open badge. This student also received the highest number of peer nominations, and he stated that the presence of the ‘CAD Buddy’ digital open

badge made him more inclined to help his classmates. Student 3 said he felt motivated by the high achiever digital open badges for two reasons: firstly, he viewed the badge as an added bonus for getting over 80% in an assessment, and so it gave him something to aim for, and secondly, he felt motivated to get those badges when he saw his classmates getting them. When asked about a leaderboard approach, Student 3 said he felt it would be a good idea, and that the competition would motivate people to do well. He did acknowledge, however, that care would be needed to ensure those students near the bottom would not feel isolated. He offered a potential compromise for the leaderboard approach: if the leaderboard showed number of digital open badges earned, and not actual grades, then it might be more acceptable because some students just might not be interested in getting the badges. This is an example of student consultation in the design of a digital open badge scheme. It also suggests that students will have differing levels of interest in the digital open badge scheme, and that they can make choices about level of engagement with it.

When asked about any difference in motivation between getting just a grade and getting a digital open badge as well for assessments, all four students were clear that the badges offer value in addition to the grade. Student 1 said that he felt the digital open badge is stronger proof of improvement. Student 2 said that the digital open badge makes it easier to see your improvement, giving you confidence that could transfer into other modules. Student 3 said that the ‘improver’ digital open badge is a good way to show you are getting better at the module material, especially if you are not at the standard where you can obtain the high achiever badges. This shows that the scheme design accommodates learners at different levels. This student also reported that the digital open badges are a way to show excellence in certain tasks and that the badges can give you a confidence boost: ‘Yeah, it does give you a little lift like...it's proof there to you that you're actually getting better, like, you're improving as you go on’ (Student 3). Student 4 said that the graphical nature of the digital open badge sends a stronger message than numerical feedback, citing the ‘improver’ digital open badge as reassurance of ability to improve. He said that digital open badges make a big difference in the way students engage with a module: if you are not doing well in the module, the digital open badges would help you improve as they give

you something to aim for, and that they are a way to show you that you should be more confident.

- Student interview Question 6. How involved in the digital badge process did you feel?

There are two aspects of involvement implied in this question. Firstly, involvement in the design of the digital open badge scheme through the surveys, and secondly through actively engaging with earning digital open badges during the implementation stage. All four students said that they felt involved in the digital open badge scheme. Student 1 felt involved because the digital open badges were prominent in the CAD module, and he suggested that badges should be used in other modules too. He said that the ability to suggest digital open badge ideas in the surveys, earning the badges and the process of nominating peers for the CAD Buddy badge made him feel involved.

‘Well from being the recipient of a few of the badges anyway, I feel I was involved in it..... And then the buddy badge, say, being able to nominate people, I think that was, yeah, I think you were involved in that one too.’
(Student 1)

Similarly, Students 2, 3, and 4 all said that the ability to make nominations made them feel involved. Student 2 said that he felt involved by earning digital open badges. Student 3 said that he felt more involved in the first Semester, when he made nominations. He expressed disappointment, because even though he felt he was helpful, he did not earn any nominations, and so he suggested that there should be more awareness of the ‘CAD Buddy’ digital open badges in future. Student 4 said that digital open badges would boost your confidence if you got them, but that you might forget about them if you did not get them. He also said that the act of nominating a classmate for a digital open badge would make you want to earn one yourself.

The practice of peer nomination arose with all four students on this question. Each student was asked three follow-up questions to gather more views on this aspect. Firstly, they were asked if they felt there were any risks to quality with peer nomination. All four students were cautiously optimistic that the nomination process would be genuine and not abused. Student 1 suggested that the risk could

be countered by the nominator having to provide a good reason for the nomination, which could then be verified by the lecturer. Student 2 simply stated that he was hopeful that students would not abuse the nomination system. Student 3 said that human nature is such that you would try to get as many nominations as possible, but that lecturer involvement in reviewing nominations would keep people honest and result in genuine nominations. Student 4 said that friends might keep nominating friends, but that might just be because they are always helping each other rather than being dishonest. He added that if nominations are made for a helper by multiple students claiming to have been helped, that might indicate a more genuine helper.

Secondly, the students were asked whether there is a difference in value between a digital open badge awarded by their peers and one awarded by their lecturer. Student 1 suggested there is a big difference, and the positive feeling you get from being nominated by classmates motivates you to help again. Student 2 also said there is a difference, in that classmates spend more time with you than a lecturer and so they know you better. Students 3 and 4 are less clear on a difference, with Student 3 stating that some people might see more value in a digital open badge awarded by the lecturer, as the lecturer is seen as the expert.

Thirdly, they were asked which issuer offers the more valuable digital open badge. Student 3 followed his previous comment very quickly to say that even though some people might place higher value on the lecturer-issued digital open badge, he would prefer one issued by his peers as it would indicate that he has earned their respect. He said that this more closely represents the way you have to get on in the real-world.

‘it kind of shows that you're kinda respected within your class and people will go to you for help....just in the real world, it's better for you to be able to communicate with people and stuff. It makes life easier out in workspaces and everything’ (Student 3)

Student 1 also said he viewed peer-issued digital open badges as more valuable, as it shows you can take on information and then pass it on in a way that your peers can understand. This is an example of a social constructivist approach, where students are negotiating a shared meaning for what the CAD Buddy digital open

badge means to them. The students are also in control of deciding who to nominate and for what reason: the value of the helpfulness is determined by the student being helped. Student 2 was less confident, stating that he views the peer-issued digital open badge as more valuable, but not by much. Student 4 said that he believed the peer issued digital open badges would probably look better than the lecturer issued ones, as it shows you are able to communicate and get on with people. However, he stated that having a mix of issuer is desirable, as digital open badges from your lecturer give a feeling that the lecturer has confidence in your ability.

‘It’s nice to get recognition of your lecturer too, that you know they can see in your performance within the class, like, that you’re trying to improve yourself, or that maybe, you know, you’re trying to get good grades and it’s kind of nice to get that feeling as well that they have confidence in you’ (Student 4)

- Student interview Question 7. Would you like to see badges in other modules in Year 1, and/or carried through the CAD module into Year 2?

All four students were in favour of broadening the scheme out, but in different ways. Student 1 said he would like to see digital open badges continued through all years on the programme. He felt that the ‘CAD Buddy’ digital open badges offered an additional way of saying thanks to a helpful classmate, and that lack of such badges in other modules might create uncertainty about whether you are being helpful or not. Student 2 said he would like to see digital open badges in the Year 2 CAD module, as they would show consistency in your skill levels as you move closer to employment:

‘if you can show that two years in a row, you’ve produced the best project... this could really show then to a future employer that you can move on from CAD to Revit and you’re able to use both softwares to a really high standard’ (Student 2)

[Note: ‘Revit’ is the name of the software used in Year 2 to follow on from the Year 1 CAD module]

He said that if you did not earn any ‘CAD Buddy’ digital open badges in Year 1, but you then went on to earn them in Year 2, it would be a sign that you are maturing. Student 4 said he would like to see digital open badges in other Year 1 modules, claiming that the confidence resulting from earning them would be helpful in other modules, and that badges would keep you interested in other modules: ‘it might help students to get on better and might give them that confidence...it would keep people interested in the module.’ Student 3 offered a more cautious sentiment. He said that digital open badges might be suited to some modules, but not all, and that they are well suited to the CAD module due to the focus in that module on computer applications and skills. He said that due to CAD being such a new concept, most students need help at the start and that digital open badges are a good way for people to track their progress. This echoes very closely the difficulty for the novice learner of CAD identified in Li et al. (2012).

- Student interview Question 8. What activities, behaviours or accomplishments would you like to see badges awarded for? Follow-up: Why do/do not the present set meet these?

All four students felt that the scheme as it exists covers enough aspects. Student 1 reiterated the value of the ‘100% Attendance’ digital open badge from an employability point of view, and the ‘improver’ digital open badge to show that the earner is not happy to settle for low grades. He said that he could not think of anything that needed to be added to the scheme. Student 2 said that all aspects are well covered, and there is no need to add anything else. Student 3 said there was nothing to add to the scheme as it covers everything without being complicated:

‘I think you've nailed it on the head already, with your buddy badges, your CAD improvers and your assessments, and even your level up...I don't think you need to do anything else’ (Student 3)

This suggests that efforts should be more focussed on implementation rather than expansion of the set of digital open badges in the scheme. He reiterated the value of the ‘CAD Buddy’ digital open badge as a way to recognise the peer learning that happens in the CAD module, particularly when new users get stuck at the early stages. Student 4 said that the set of digital open badges represents a very reasonable list, and that there is something in the scheme that everyone should be

capable of obtaining. This is interpreted to mean that the digital open badge scheme supports students who have specific strengths, and it also supports students who have weaknesses. He did suggest, however, that an overall ‘Best in Class’ digital open badge for the student with the highest overall final grade could be added.

- Student interview Question 9. Did you share any of the digital badges you earned? Follow-up: Why/why not? Where?

Student 1 and Student 2 have actively shared digital open badges. In the case of Student 1, he shared the ‘100% Attendance’ digital open badge on his CV, stating that he felt this was proof of reliability for prospective employers: ‘it goes to show to the workforce again like that when you are employed that you will show up’. He said that digital open badges could send a message about the earner: in the case of the ‘100% Attendance’ digital open badge, this message would be positive but he felt that the ‘Level-up’ digital open badge might make an employer think the earner could not work under pressure. Student 2 used the ‘CAD Buddy’ digital open badge on his CV, stating that this would show prospective employers that the earner can work well as part of a team. Student 3 explained that he does not share anything on social media, but that he did discuss the digital open badges with his classmates and friends outside of class. He said that he does not yet have a LinkedIn profile, but that he would share the digital open badges on that platform when he sets up his profile. The reason he gave for this is that the digital open badges add to the story he is trying to tell about himself, and that they are an extra factor for prospective employers to look at above and beyond grades. Student 4 did not earn any digital open badges, and so was not in a position to share them. He did indicate, however, that had he earned any he would have shared them. He identified two reasons for sharing: firstly, he would share with his friends, as getting a compliment on them from others would provide a confidence boost for him, and secondly, he said he would share them on a CV to demonstrate technical capability and a willingness to help others:

‘...to hear that would really kind of boost me to think "Well, okay, I'm very good at this". And, if I was applying for a job or something, it's something I'd definitely have on my CV just to show...businesses and

companies like that I'm capable of doing good work and helping other people' (Student 4)

- Student interview Question 10. Did you like the way in which the Mystery Badges were run? Follow-up: If you had known the mechanism for earning in advance, would it have affected your behaviour? Why/why not?

All four students responded positively to the inclusion of 'Mystery Badges' in the scheme in general, although there were some reservations. Student 1 and Student 3 made very similar comments to each other, saying that not knowing what the digital open badges were going to be issued for added intrigue to the scheme, and this became a discussion piece within the class. Student 4 claimed that the 'Mystery Badges' kept students interested in going to class, as they were never sure for what activity or on what day a digital open badge might be awarded. The students were each asked a follow-up question relating to how prior knowledge of how to earn the 'Mystery Badges' might have affected their behaviour. Students 1 and 2 expressed the view that knowing about the '100% Attendance' digital open badges and how to earn them in advance would change the behaviour of some students. Student 1 said it would motivate a student to attend if they were close to earning an attendance digital open badge and they did not feel like going to class: 'the attendance ones would change your behaviour to go in, to have the badges'. This change in behaviour was noted by Student 2 also. He said that it might make some students attend better if they knew in advance about the '100% Attendance' digital open badges: 'some people may not have been inclined to come in every day, but if they knew they're going to get one for full attendance, they might have thought I won't miss this class.' Student 4 was definite in his view that knowing in advance about the '100% Attendance' digital open badge would encourage students to keep their attendance rate up, as that badge would look good to prospective employers. Student 3 held a different view: he said that knowing in advance would not change his behaviour, as he was going to attend as much or as little as he wanted in any case. This again shows that students will engage differently with the digital open badge scheme, and that they have control over setting their own goals for achieving digital open badges.

The students were then asked about the 'Best Mentor' digital open badge, which was a 'Mystery Badge' associated with number of peer nominations. There were mixed views on this. Student 1 was in favour of knowing about the 'Best Mentor' digital open badge and how to earn it in advance, saying that this would motivate him to help others. Similarly, Student 2 contended that students did not understand the value of the 'CAD Buddy' digital open badge, and that knowing how to earn the 'Best Mentor' digital open badge in advance would help this understanding and would have motivated students to help each other. Students 3 and 4 held different viewpoints to this. Student 3 said that knowing about how to earn it in advance would have changed his behaviour: he said that he would nominate a helpful classmate in any case, but knowing about the digital open badge would have made him follow-up with a student he helped, in order to make sure he got a nomination. He did say, however, that leaving the 'Best Mentor' digital open badge as a mystery would be the best way to avoid any problems with non-genuine nominations. This last sentiment was also expressed by Student 4, who said that leaving the 'Best Mentor' digital open badge as a mystery might ensure that only genuine nominations are made. Student 4 saw benefits in terms of attendance level for both transparency and for mystery: he said that knowing about the attendance digital open badge in advance would have the effect of making you attend, and having a 'Mystery' digital open badge that you did not know about in advance would also make you attend, in case such a digital open badge was being awarded on any given day for some reason: '...it kept people interested in going to class and being there, because you obviously didn't want to miss it.'

4.5.2 Thematic analysis of interviews.

Initial coding of the transcripts using nVivo resulted in 18 nodes, a further 25 sub-nodes, and a total number of 366 references tagged across the four interview transcripts. All 43 node names and frequencies were exported to Excel, where they were sorted by the number of referenced items in each node. This helped identify initial nodes that had a much higher number of references than the others. The top ten nodes based on number of references were (with number of references in brackets): demonstrate (77), motivation (36), feelings (34), improvement (31), mystery badges (27), nomination (24), desire for badges (21), help (18), scheme

(17), employability (16). These initial codes fall into five categories which relate to the meaning and value that users and readers might place on digital open badges, the way in which digital open badges might influence student behaviour, the emotional response that the student has to earning digital open badges, elements of peer learning that the digital open badges can facilitate, and viewpoints that should be considered for future implementation of a digital open badge scheme.

These categories form five themes for the analysis of the interview data. New nodes were created in nVivo to represent these themes, and the initial nodes were reorganised into the appropriate theme. The five themes are: meaning and value (144 references), emotional response (61 references), influence on behaviour (57 references), future implementation (55 references) and peer aspect (49 references). Table 4.31, below, shows the five themes, the nodes created and the number of references tagged in the transcripts for each.

Table 4.31 Themes and nodes used in nVivo

Theme	Node Name	References
Meaning and value	Self	31
	Improvement	31
	peer issued badges	6
	Others	47
	Employability	19
	Sharing	10
Emotional response	desire for badges	14
	Confidence	18
	Positive	13
	Involved	9
	Uncertainty	5
	Uninvolved	2
Influence on behaviour	Influence on behaviour	7
	Motivation	42
	Engagement	8
Future implementation	Broadening	7
	Sufficient	12
	Suggestions	5
	Leaderboard	4
	Mystery	4
	knowing in advance	15
	Positive	8
Peer aspect	helping others	17
	helping self	6
	Nominating	16
	Negative	6
	being nominated	3
	Positive	1

4.5.2.1 The meaning and value of digital open badges.

The students have assigned meanings and values to the digital open badges in terms of what the badges can offer to themselves and in terms of what the badges can offer others. Considering the role of digital open badges to the self firstly, there is strong evidence in the interview data that the students view the badges as a means of mapping their improvement through the CAD module. The students talk a lot about how the digital open badges ‘show’ something to themselves, for example Student 3 said ‘...because it shows that you are improving, like, and if you’re getting badges for it as well like, it’s another plus....it’s just there to show you....’ when talking about the ‘CAD Improver’ digital open badge. Given the prevalence for comments like this, it appears that students like to have a way to reassure themselves of their ability and performance on the module. This reassurance has the effect of increasing engagement and effort by the students. For example, when Student 4 was talking about the ‘CAD Improver’ digital open badge, he said ‘...it might help students to get on better and might give them that confidence....it would keep people interested in the module.’ Here we see digital open badges as a means of generating interest in a module, due to the meaning a student has read into their value. Even when the digital open badges are not associated with a grade, such as the ‘Level-up’ badges, the students still associate the badge with a signal to themselves. Of this type of digital open badge, Student 4 said ‘...the Level Up badge might just show to yourself...that you’re capable of getting a better grade’. In this case, the perceived meaning of the digital open badge is that it is an indicator of potential future performance in the module.

Moving on to what the students see as the value and meaning of the digital open badges to consumers other than themselves, there appears to be three audience groups that the students are concerned with. These are their lecturers, their peers and potential employers. In terms of the lecturer, the students see earning digital open badges as a way to show that they have been listening in class, and that they are capable of performing well in the module. None of the students considered that the lecturer may already have that sense about a student based on looking at their grades, so perhaps the students see the digital open badges as some sort of extra proof that the lecturer needs to see. This would indicate that students value digital open badges just as much as, or perhaps more than a grade. For example,

Student 4 said ‘it’s nice to get the recognition of...your lecturer too, that you know they can see in your performance within the class, like, that you’re trying to improve yourself’. In terms of how the students see meaning in the digital open badges when thinking about their peers, the value seems to be in the prestige of obtaining a digital open badge that others have not earned. Student 1, when talking about the ‘Best in Class’ digital open badges, said he would ‘put it out there and show that you are the best at doing that project, that you have the skills of becoming the best’. Student 2 made a similar comment about that type of digital open badge: ‘it shows...that you’re right up there at the top of the class...and you’re able to show other people’. However, this element of prestige was not confined to being at the top of the class in terms of just academic performance. Student 3 saw value in the ‘CAD Buddy’ digital open badges as a way ‘to show that you’re able to help people and communicate with others’. There is no clear distinction in this comment as to which target audience he had in mind, but given the value (discussed later) placed on obtaining a peer nominated digital open badge, it would be in the student’s interest to let his peers know he was predisposed to being helpful in order to gain even more nominations. This notion that obtaining the ‘CAD Buddy’ digital open badges is evidence of good communication skills arises multiple times with all four interviewees. Considering there is no distinct “Communications” module on the degree programme, perhaps this affords an extra value onto the ‘CAD Buddy’ digital open badge, as it may become the only piece of evidence that a student obtains to assert they have such skills. There is a reciprocal value associated with the ‘CAD Buddy’ digital open badges also. Student 4 believes that by nominating a student for such a badge, not only are you ‘showing them that you believe that they’re very good at what they’re doing’, but that ‘they’ve improved you as well’. Here we are seeing a double value, where both the earner and the nominator are getting some reward for their effort. Another meaning associated with the digital open badges when students consider how they share them with their peers is that the students make the assumption that the consumer of the digital open badge will interpret the badge to mean the student is doing well on the module, which might lead to praise and a confidence boost. So, the value of the digital open badge is that it will result in encouragement for the earner.

All four students interviewed saw a value in digital open badges when thinking about seeking employment. The students have assigned meanings to the digital open badges, which they assume will align with meanings that potential employers will interpret. For example, there are several references across the interviews to digital open badges being an asset when writing a CV, and the preference seems to be for sharing badges that provide evidence of additional traits beyond what a set of grades would say about a student. There are three digital open badge types in particular that emerge as being useful for future employability. Firstly, the students see the ‘CAD Improver’ and ‘Level-up’ digital open badges as being a clear way to assure potential employers that they are willing to constantly strive to get better, perhaps indicating a commitment to lifelong learning. For example, Student 2 said ‘...shows an employer that you’re determined...you want to improve on everything that you do’. Secondly, the students see the ‘100% Attendance’ digital open badges as sending a positive message to potential employers. Nowhere in the CAD module (or more broadly, in any module on the programme) is the student commitment and reliability recorded and rewarded. Therefore, the ‘100% Attendance’ digital open badge is a unique way for the earner to provide evidence of such qualities. As Student 1 said ‘...it goes to show the workforce that when you are employed you will show up’. Thirdly, the students have placed meaning and value on the ‘CAD Buddy’ digital open badges which they feel would help them at the point of seeking employment.

The meanings associated with the ‘CAD Buddy’ digital open badges, which are issued based on peer nomination, are regarded by the students more highly than ones issued by the lecturer (based on assessment performance). The reasons given centre on the peer learning that takes place beyond the classroom, and therefore is not visible to the lecturer. Such peer learning appears to mean more to the students, as it goes beyond the reward of a grade-based digital open badge. For example, Student 4 said that potential employers ‘...might look at it better than what the lecturer would give.....it kind of shows that you’re kinda respected within your class and people will go to you for help...’. Student 2 said something similar: ‘I think it nearly means more from your classmates, because they’re the people you’re in-class with every day.’ So, the students have assigned a community of practice element to the ‘CAD Buddy’ digital open badges which

they feel says more about them than a lecturer issued badge. The value of this is that when seeking employment, the students view these digital open badges as being a way to show qualities to prospective employers that go beyond what would normally be seen on a CV. Student 1 said that these digital open badges ‘...show future employers that I can work as part of a team’. Student 3 goes into more detail about how a potential employer would view such a digital open badge:

‘...it shows your employers who are looking you up.....it's just an extra thing you're adding on there like for them to look at, like. It kind of tells a bit of a story about yourself as well, what you were like in class or what you were like in college aswell. It's an extra thing for them than just looking at previous work or results or whatever, it's some...it's a little bonus’. (Student 3)

The only instance recorded where a student felt the digital open badges might send a negative message to prospective employers was in the interpretation by Student 1 of the ‘Level -up’ badges. Student 1 recognised multiple meanings for this type of digital open badge, depending on who is consuming it. While he felt that ‘the level up ones... I'd love to earn them ones to just have for yourself’, he also attributed a negative connotation for this digital open badge type where a potential employer might interpret it to mean

‘that when push came to shove you didn't do great, but then when the stress was kind of over and wasn't as much stress on you, that you did better. It mightn't show that you're great under stress or under time limit.’ (Student 1)

This is evidence of the student is projecting a different meaning onto the same badge, depending on who is reading it. In this instance, Student 1 sees the ‘Level-up’ digital open badge as a token that signifies a weakness. He felt that he would share digital open badges which sent out a positive message about him, but that he would not share one that could be interpreted negatively: this shows that the badge earners have control in how they interact with the digital open badge scheme and what actions they can take with badges they have earned.

4.5.2.2 There is an emotional response to earning digital open badges.

All four students expressed generally positive feelings towards earning the digital open badges. The feelings fall into sub-themes of desirability of digital open badges, positivity as a result of the earning badges, confidence building, feelings of involvement with the scheme and how the absence of the digital open badge scheme could lead to uncertainty. There were no instances of negativity about the digital open badge scheme itself, with many comments such as this, from Student 3: ‘...it does look well at the end of the year, or on your CV, that you have these badges.’ However, there is an implication of disappointment where specific digital open badges were not obtained. For example, Student 2 did not achieve the ‘Best Project’ digital open badge even though he had a clear desire to obtain it: ‘...the Best CAD Project in Class, that was one of the ones I would have liked to get’. This student views the ‘Best in Class’ digital open badges as complimentary to the ‘CAD Buddy’ one he had received: ‘they sort of go hand in hand that you're right up there at the top of the class, you know exactly what happened in first year, and you're able to show other people then as well.’ The students, therefore, seem to have bought-into the digital open badge scheme to the point where they feel motivated to want to earn the badges. One reason why the students want to earn the digital open badges is because of the links to employability, as discussed above. However, a more internalised reason emerges from the data too, in that earning the digital open badges makes the students feel good. Student 1 said

‘...when you realize that they'll nominate you for this, you get a great feeling about when you get the badge that you did help someone along their way and you taught them something that they weren't fully sure about.’ (Student 1)

Here we see the students negotiating their own meaning onto earning a digital open badge through peer nomination, where the outcome is a good feeling in addition to a digital open badge that might be useful when seeking employment. This suggests an altruistic function of the digital open badges. Student 3 reported that he nominated some classmates for the ‘CAD Buddy’ digital open badge, and that ‘...they were happy enough because they didn't think anything was gonna

come out at the end of it, but then I know one of the lads did, and he was pretty happy’.

There is a strong evidence throughout the interviews to support the view that earning digital open badges creates a feeling of confidence. There are two ways in which confidence appears to fit into the scheme. Firstly, earning digital open badges related to assessment performance appears to provide a boost in confidence which has the effect of encouraging the earner to improve in subsequent tests. This is not only linked to digital open badges awarded for high achievers, but in relation to the ‘CAD Improver’ badges (where there is no minimum grade requirement to earn). Student 2 said the value in this digital open badge is that ‘...it just gives you confidence, for people that mightn't be as strong, or mightn't be as confident using the software’. It is unclear what the longevity of this provision of confidence might be, but Student 4 said that ‘it reassures you now, like, that you are able to improve the whole time on your work.’ This suggests that the confidence boost can affect you for more than just the moment in time when you get the badge. Secondly, where a student believes earning the digital open badge means that others have confidence in them, this has a positive effect on their feelings. When referring to getting digital open badges from the lecturer, Student 4 said that ‘it's kind of nice to get that feeling as well that they have confidence in you, to know that you have the ability to get on well.’ Here the student equates earning a digital open badge with earning the respect of the lecturer.

In terms of involvement in the scheme, all four students expressed that they did feel involved. There were a number of reasons given for this: the students felt involved in the design of the scheme through the surveys, by earning the digital open badges and by being able to nominate peers for a badge. This shows three ways in which the students recognised the student-centred approach, and this can be interpreted as evidence of a collaborative process within the scheme. There were, however, two instances where students became disengaged with the digital open badge scheme, related to lack of involvement. Firstly, Student 3 reported that he felt less involved in the second semester. The reason given is that he made nominations in the first semester, but felt that these were not reciprocated when he felt sure he had helped others. Perhaps this indicates a lack of altruism on his part,

where he lost interest when he did not receive any nominations and so was less inclined to help others. Secondly, Student 4 explained that in retrospect he wishes he had become more involved, because he became disinterested at the early stages and so less involved in the digital open badges and more focussed on just passing the module. This student was able to communicate that he saw values and meanings for the digital open badges in retrospect that he did not see at the time. This suggests that there is scope for informing the students more clearly about the advantages of digital open badges at the early stages and throughout their implementation.

Finally, there was a feeling of uncertainty associated with the use of digital open badges, more specifically where there is a lack of digital open badges. This was expressed by one student and related to how a lack of digital open badges in other modules makes it difficult to know if you are being helpful to a classmate. This implies that the presence of the digital open badges offers certainty to the students. Even though uncertainty could be interpreted as a negative emotion, in this case the remedy is to broaden the use of digital open badges into other modules. This reinforces the value of the ‘CAD Buddy’ digital open badge as a good mechanism for allowing students to verify for each other that they are being helpful.

4.5.2.3 Digital open badges influence learner behaviour.

Two key aspects of learner behaviour of interest are motivation and engagement. Engagement here is understood to mean interest in the module and attendance at classes. Motivation can be intrinsic (where a learner wishes to prove something to himself/herself) or extrinsic, where there is some perceived reward for performing in a manner that is worthy of broadcast. Digital open badges in this study have been shown to influence both engagement and motivation. Considering engagement firstly, there is strong evidence to support the idea that the opportunity to earn digital open badges for attendance affects how learners approach the module. For example, Student 1 said ‘...the Attendance ones would change your behaviour to go in to have the badges’ and Student 4 said ‘the attendance one, if I had known about it, I think I definitely would have kept my attendance at a better rate.’ This goes back to the meaning and value that the students have placed on the ‘100% Attendance’ digital open badges: not only have

they negotiated a meaning, but they value this to an extent such that it would actively change their behaviour. A second influence that digital open badges can have on engagement is adding to the interest levels of students on the module. This seems to be linked most strongly with the 'Mystery' digital open badges, where lack of prior knowledge about what they were and how to earn them added intrigue to the module. This is not an emotional response that is usual in the learning environment, so it is interesting that it arises here. Student 3 said '...there's a bit of mystery, like, intrigue, you're always going to be wondering what they were.' Student 4 said that the 'mystery badges were probably a good thing, because it kept people interested in going to the class...'. Here we see a double benefit in how digital open badges can influence student engagement: a badge for attendance will encourage learners to attend, and a badge where the earning mechanism and reward are unknown to the learner will keep them interested enough to attend class.

The influence that digital open badges have on learner motivation is clearly seen in the interview data. There are multiple examples of how this motivation is manifest for the interviewees, including goal-setting, showing improvement over time, prestige, competition, confidence boosting and linking to employability. The learners imply an awareness of goal-setting as motivational factor. For example, Student 1 said 'when you have something to work for, it will push you on to try and get it', Student 2 said 'if there is a badge there for a high achiever...you want to strive to get that', Student 3 said 'if you got below 80% and then there was a badge available to you if you got over 80%, like, that was kind of an incentive' and Student 4 said '...they are valuable...they kind of show that if your motivation levels are low...they can obviously bring them up for ya.' This shows that the digital open badges are encouraging students into a frame of mind where they are striving for deeper learning by not settling for the bare minimum to pass the module. The digital open badges also provide motivation in terms of signposting improvements, even where student performance is not to the standard of the high achiever badges. For example, Student 4 said

'...maybe a little bit of extra work, d'you know, to improve on that previous grade would be a help and I think the level up badge would

probably give you that bit of confidence, you know, to help yourself.’
(Student 4)

The digital open badges are therefore seen not only as a reassurance, but as something to work harder to obtain. There is also evidence of motivation due to the perceived prestige of earning a digital open badge. Referring to the ‘Best Project in Class’ digital open badge (which only one student can earn), Student 2 said ‘I spent a lot of time on the end of year project. I spent a lot of hours on that working on some smaller finer details, trying to get that, trying to get the badges.’ Again, this shows a commitment to deeper learning, where the student is not content with obtaining any grade: he wants the highest grade in the class for the project and is willing to spend extra time working to achieve that. This shows that digital open badges encourage students to perform to a high level. The value of prestige is not confined to a high level of academic performance. When talking about the ‘100% Attendance’ digital open badge, Student 1 said:

‘...I shared the 100% Attendance one because I got the mystery badge, because it wasn’t everyone that actually got it...I think there was only six or seven in the class that got them, like. There was very few of them and so I did show that one ’cause it was probably the best one that I had out of the lot.’ (Student 1)

This suggests that the rarity of the digital open badge adds a prestige value to it and adds to the motivation to obtain that badge by attending all classes in the module.

There is a motivational effect due to competition to earn digital open badges. Student 3 said

‘...I know from talking with a few of the class lads last year, like, they’d be striving to get over 80, and it’s just a bit of competition between classmates...competition is always good for students, keeps you on your toes a wee bit.’ (Student 3)

While this could be interpreted to mean competition in general, regardless of digital open badges, Student 3 goes on to say ‘...especially if you see one of your classmates and you see he’s getting a badge and you’re not, it does drive you on a

wee bit more.’ This points to the students having a shared understanding of the value of the digital open badge as a signifier of performing well when compared to their peers. In this case the digital open badge is explicitly related to high academic performance in assessment, although the motivational effect of comparing badge acquisition is also evident in more general terms. For example, Student 3 said

‘...a couple of times when I seen, d’you know, my other colleagues around me, or students...when they were getting badges, you know, I often kind of thought to myself it’d be nice to be able to get one of them.’
(Student 3)

This goes back to the desirability of digital open badges, but in this case the desire is driven by seeing others getting them.

Motivation occurs as a result of the increase in self-confidence provided by earning digital open badges. Student 4, when talking about earning the ‘Improver’ digital open badges, said

‘...if you’re improving as you go along in your assessments, d’you know, you’re going to build up more confidence and you’ll want to kind of do well in your work and go about it properly.’ (Student 4)

Furthermore, this motivational effect is not limited to the module within which the digital open badges were trialled. Student 2 said that students

‘...might just need something...for them to look at and think ‘oh well, I have improved from that CA or that exam to that exam, so I want to do the same now in engineering science, I want to do the same now in Maths’.’
(Student 2)

This suggests that the confidence gained from earning digital open badges in one module can have a motivational effect elsewhere on the programme.

The meaning and value of digital open badges linked to employability has already been outlined. There is clear evidence that this value has a motivational effect on the learners. Student 2 said that he would work hard to obtain the ‘Best in Class’ digital open badges ‘to show a future employer that...you’re able to use software to a really high standard.’ Student 3 expressed motivation with a view to

employability also, when he said he would ‘be striving to get them, just to have them so it’s an option to put on my CV, so employers can actually take a look at what you were like at college...’ Here the motivation seems to be that the digital open badges have a utility on a CV that cannot be met by another means. This motivation to earn digital open badges is also in evidence when Student 4 said

‘it would be nice to have one of those badges and maybe it would look good for yourself personally in the future, you know, well, now’s the chance to push myself to do a bit better.’ (Student 4)

This indicates that the students have a sense of forward planning for success which is motivating them to make a better effort on the module where the digital open badges are available.

4.5.2.4 *Learner views on future implementation of digital open badges*

The students interviewed thought that the digital open badge scheme was sufficient in terms of the range of badges on offer. Most comments were similar to Student 1 when he said ‘they do cover a wide range of the module....I don’t think there’s anything really that they don’t cover,’ and Student 3 ‘I think you’ve nailed it on the head already...I don’t think you need to do anything else.’ The only suggestion that was made for an addition to the scheme came from Student 4, who suggested that an overall ‘best in class’ digital open badge could be added for the student obtaining the highest overall grade. There were, however, several suggestions to be considered for future implementation in terms of how the digital open badge scheme is operated (as opposed to what the scheme should contain). These relate to the use of digital open badges in other modules and/or years on the programme, promotion of the digital open badge scheme, the use of a leader board, the nomination system and the manner in which the ‘Mystery Badges’ are used. There is a desire for the scheme to be broadened to other modules, both in Year 1 and in later years. The reasons given for this include the usefulness of the digital open badges to show progress of skills as the learner moves closer to employment, and that the confidence gained from earning digital open badges would be helpful in other modules. There is a need to communicate the value of the digital open badge scheme throughout the module delivery. The students are

clear on the value in retrospect, but awareness of this at an earlier stage would benefit the learners. For example, Student 3 said ‘...maybe there is scope to improve the scheme a little bit by making people a bit more aware of it...’. The perceived lack of awareness is compounded by two further factors identified by Student 3: students may not nominate a peer due to laziness, and the interface for collecting the digital open badges should be easier to access. This is an acknowledgement that different students will approach the digital open badge scheme with their own attitude. There are mixed views regarding the use of a leader board for digital open badges in the module. Student 1 said that a reason for wanting to earn digital open badges for high performance is that it shows ‘that you’re up there with the best in class’. Student 3 was clear on the motivational effect of a leader board, saying that it is ‘...actually a good idea because stuff like that does drive people further than what they’re doing.’ In terms of future implementation, however, Student 3 was conscious of the likelihood that students at the bottom of the leader board may feel isolated. As a way around this he suggested that if the leader board just showed names and number of digital open badges earned (with no grades on display) then it might be more acceptable. The implication here is that if a student chooses to not target the digital open badges in their studies, they probably will not mind if their name is at the bottom of the list. This signifies that learners are in control over the way they interact with the digital open badge scheme. Further control is afforded to the learners by means of the nomination system for the ‘CAD Buddy’ digital open badges. The implied value of a peer nominated digital open badge was clear in retrospect, but as Student 2 said ‘some people would have strived for that to show that they were able to help others’ but that ‘I don’t think people understood that it can be a really useful tool further down the line, that’s why some people may not have been involved in it.’ There is then, further evidence that more awareness of the digital open badges and their usefulness is needed in a future implementation. To ensure nominations are genuine, the students suggested maintaining the system whereby the nominations are reviewed and validated by the lecturer as part of the issuing process.

The students expressed positive views and suggestions about the ‘Mystery Badges’. The positive impact of these digital open badges is that they became a

discussion piece, and the intrigue surrounding what they were and how to earn them added interest to the module. This is interpreted to mean that the ‘Mystery Badges’ had a value that was socially constructed by the students, with the effect that engagement with the module increased. Therefore, the inclusion of ‘Mystery Badges’ in any future implementation should be considered. The question arises regarding the benefits and drawbacks of prior knowledge about what the ‘Mystery Badges’ were and how to earn them. With respect to the ‘Mystery Badges’ that related to 100% attendance, there is strong evidence to suggest that prior knowledge of these digital open badges would benefit the learners. Student 2 said ‘some people may not have been inclined to come in every day, but if they knew they they’re going to get one for full attendance, they might have thought “I won’t miss this class”’. Student 4 said about the ‘100% Attendance’ digital open badge that ‘if I had known about it, I think I definitely would have kept my attendance at a better rate’, and he clarifies his reasoning for this by saying this ‘would have stood to me as well, d’you know, it’d improve your learning.’ This is insightful, as it not only shows that prior knowledge about the digital open badge would have affected behaviour, it also shows that the student has recognised a link between attendance and improved learning. In relation to the ‘Mystery Badge’ associated with peer nominations (i.e. the ‘Best Mentor’ badge), there are mixed views about prior knowledge. A drawback of knowing what this digital open badge was and how to earn it centres on the credibility of the nominations. Student 4 felt that there was a risk that friends would habitually nominate each other if they knew about the reward on offer, and that retaining this as a ‘Mystery Badge’ would mean that nominations are more genuine. Student 3 also recognised the possible loss of honesty in the nomination system if the reward was known in advance and said leaving ‘it as a mystery is probably the best way to avoid all the other stuff that might be a problem’. This suggests that the ‘Mystery Badge’ for ‘Best Mentor in Class’ would be more acceptable if it was based on altruistic engagement with the digital open badge scheme. There is, then, an argument for including a ‘Mystery Badge’ in future implementations, but that the digital open badges for 100% attendance should be visible from the beginning.

4.5.2.5 Digital open badges encourage peer learning activities

Peer learning activities have a dual effect for the learners. Firstly, taking part in peer learning is seen as a good way to help other students, and secondly it also has the effect of benefitting the helper. As an example of where this type of activity helps others, Student 1 said the ‘CAD Buddy’ digital open badge shows

‘...that you're able to take the information in, process it yourself and share it with someone else and, like, give them a way that they might be able to....say the way I'd learn something might be different to the way the other person might learn it...so that you'd be able to take it, turn it around and show them in a way that they'd understand it and they'd be able to use that information again to help someone else.’ (Student 1)

This shows that the student is aware that different people may learn in different ways, and he is effectively utilising a social constructivist approach to negotiate a way to help others understand information and carry out tasks. He has also indicated that by engaging in this activity, the person who is helped could then become a helper for someone else. Student 4 suggests that the peer learning associated with the ‘CAD Buddy’ digital open badge would have a beneficial effect on the academic performance of a classmate. He said the ‘CAD Buddy’ digital open badge shows that ‘you’re able to help someone else out if they’re stuck, and...they may be able to benefit from that, you know, it could help them in their assessments.’ Again, we see an altruistic attitude being facilitated by earning this type of digital open badge. The student is not acting in a particular way just to get the digital open badge: he is acting in a way that will improve the outcome for his classmates. Secondly, in terms of how peer learning activity is of benefit to the helper, the ‘CAD Buddy’ digital open badge earner gets a good feeling from being recognised as a helpful classmate. Student 2 said when you ‘realize that they’ll nominate you for this, you get a great feeling when you get the badge that you did help someone along their way.’ He said this positive feeling is strong enough that ‘it’d push you towards trying to help them again.’ So the earner has an emotional response to earning the digital open badge that results in motivation to repeat the action of peer learning.

4.6 Institute management and employer reflections on Phase 2

A number of issues emerged from the analysis of the student interviews in Phase 2. Specifically, no single digital open badge emerged as the most valuable for the students, there were different views expressed relating to the meaning of the ‘Level-up’ digital open badge, and there were multiple suggestions for future implementation of the scheme. In addition to the students, two further stakeholders were interested in the digital open badge implementation during Phase 2. These are the GMIT institute manager and the employer. To address the issues emerging from the student interviews, these two stakeholders were interviewed to gain their perspectives and reflections on the implementation of the digital open badge scheme at the end of Phase 2. As the aim of these interviews was to address the same issues emergent from the student interviews and to provide overall reflections, the findings of both interviews are presented together in this section.

4.6.1 The value of digital open badges

The GMIT institute manager identified the ‘CAD Buddy’ and the related ‘Best Mentor in Class’ digital open badges as being most valuable for students, stating that this type of badge is an incentive for engaging in peer learning. Such engagement, she claimed, would help retention by encouraging an inclusive mood in the class group because it ‘helps the whole student experience, which is really important in first year’.

The employer identified the ‘Level-up’ digital open badges as being most valuable for both the students and the employer. He expressed the view that this digital open badge signifies self-awareness in the earner and provides a mechanism for a self-motivated student to pursue better skills mastery:

‘...the individual that takes that on, knowing that his original grade on paper doesn't change, but he knows himself, that he will improve: I think that's really good. And I'd be looking out for that individual. That's the individual I want working in this organization.’ (Employer)

In each case, the institute manager and the employer identified digital open badges not directly related to assessment performance as being most valuable for the students. This corresponds with the type of digital open badges that the students reported as being most valuable also.

More generally, the employer sees further value in the digital open badge scheme beyond individual specific badges. He sees the digital open badges as something that ‘encourages lifelong learning, self-learning, a roadmap to improve, encourage lessons learned’, in a way that aligns with the approach taken towards continuous professional development (CPD) in the industry. He said that the digital open badge scheme ‘promotes ongoing CPD before they ever leave college...all businesses like us have a requirement to have an approach and systems in place for ongoing CPD. This encourages that, this prepares them for that.’

With respect to the value of digital open badges to the institute, the institute manager identified the ‘Level-up’ as most valuable. An aim of the institute is to encourage student engagement, and the ‘Level-up’ digital open badge promotes a culture of engagement beyond the bare minimum: ‘I think it helps people maybe not to just go for the 40%, just get over the line, I think it's actually fully engaging them in participation of learning in higher education.’

The value of digital open badges relies on stakeholder trust in the scheme. The institute manager sees gaining the trust of prospective employers as vital to its success. She suggests that involving the employers in the design of the digital open badge scheme helps to build trust. She has the view that employers in the construction sector are open to changes in technology and will understand what the digital open badges are about when they see them on job applications and then view the badge descriptions. The employer supports this view by claiming that he would notice a digital open badge included in a job application and would discuss it at interview stage. He offers a distinction, however, in how the trust is gained depending on what the digital open badge signifies. For example, he stated that he would trust that a digital open badge for 100% attendance in class was genuinely earned because he trusts that the attendance record kept by GMIT staff would be accurate. However, he views digital open badges earned for other criteria (high performance at skills and behaviours such as mentoring and self-improvement)

differently when considering trust. For these types of digital open badges, trust has to be earned by ‘testing that process, you know, seeing how people that have come in with those CVs, work out over a period of three to six to nine months’. The trust in those types of digital open badges is built based on how the candidates perform initially and over time in the workplace.

4.6.2 The meaning of the ‘Level-up’ digital open badge

Both the institute manager and the employer were very clear in their interpretation of the ‘Level-up’ digital open badges as signifying something positive about the earner. The institute manager interprets this badge to mean the earner is self-motivated, and that they are aware the bare minimum in terms of skills mastery is not good enough when learning skills needed in other aspects of their studies. She said that if a learner demonstrates that they are willing to learn more and improve, then it ‘bodes very well, for their future, and for their attitude towards education.’ Reflecting on the negative interpretation of the ‘Level-up’ digital open badge expressed in one of the student interviews, she suggested that this badge can be used in a positive way at job interview stage:

‘...a lot of people get nervous in interviews, as well as exams, and so if you go into an interview, and you're nervous, you can use that and you can say, 'Well, actually, you know, you can see how nervous I am now, that was exactly the way I was in that exam. But afterwards, I went and I sorted it out by doing this extra work'.’ (Institute manager)

The institute manager argued that the ‘Level-up’ digital open badge indicates that the recipient recognizes scope to improve and has acted upon it. She sees putting in extra time and effort to get better as a quality that prospective employers would value:

‘...somebody who's more aware of themselves and would actually say, 'Well, actually, when I think about that now, I need to go back and fix that' and will go back into the office later on in their own time and fix it or recheck something. I'd much prefer to have somebody like that.’ (Institute manager)

The fact that the mechanism is optional and that no grade change results from the second attempt means that the students must choose to engage with this digital

open badge. The employer claimed that a student pursuing the ‘Level-up’ digital open badge is demonstrating the quality of work ethic that is desirable in the workplace. He argues that the type of person who earns the ‘Level-up’ digital open badge has a an ‘...’I want to do better, I can do better’ mentality, and that’s the culture that you want in an organisation like ours or others in the industry’. According to the employer, displaying the ‘Level-up’ digital open badge on a CV would be an honest and positive inclusion because it is an indicator of a good reaction to a bad performance. He indicated that any digital open badge appearing on a CV would be questioned at interview stage, and the inclusion of the ‘Level-up’ one would afford the interviewee an opportunity to talk about their self-reflecting qualities.

4.6.3 The future of the digital open badge scheme

The employer sees the potential for broadening the scheme so that it includes other software relevant to the civil engineering discipline. The roadmap provided by the digital open badge scheme would then be extended to ‘form part of a much bigger picture.’ He reported that he felt engaged with the scheme and offered the ‘Best Mentor’ badge (which was designed and implemented in conjunction with the employer) as ‘proof of that’. The employer spent time with the student who earned this digital open badge, and so his engagement goes beyond simply participating in interviews and developing that badge. He expressed a willingness to provide ongoing support for the digital open badge scheme, including rewarding earners of the ‘Best Mentor’ and ‘Level-up’ digital open badges with guest treatment in the design office for a day.

In terms of broadening the digital open badge scheme beyond civil engineering at the GMIT, the employer suggests that presenting the scheme to professional bodies within the construction sector would be a valuable next step. This would allow the scheme to be recognized externally in terms of CPD, which would make employer buy-in easier.

From the institute perspective, the institute manager associates earning digital open badges with showing initiative; a quality that the institute would like to encourage. She views the digital open badge scheme as a support mechanism for continual communication:

‘...the more engagement or communication that we have, between staff and students and between students and their peers, it just enhances everybody's experience of the group as they go through. And I think that's something that needs to be nurtured. Anything that supports that is brilliant’. (Institute manager)

For future implementations of the digital open badge scheme, the institute manager identifies advantages to the institute and the students in relation to the ‘CAD Buddy’ and attendance badges. Recognising and rewarding the peer learning aspect in the learning environment is important for her:

‘...in some cases, maybe engagement is more important than actual attendance, which is why I like that mentoring one or the peer learning one. Because I do think that, you know, as a lecturer, you see, sometimes students completely tuning out because they're tired or whatever, but as soon as you put them in groups and get them to respond to their peers, they're suddenly engaged again. So that whole peer thing is very, very important’. (Institute manager)

In relation to issues within the department which digital open badges might help, the institute manager offered several examples. Firstly, she views the digital open badges in general as motivational and ‘...anything that motivates the student, and that supports them in what they're trying to achieve for themselves, is very important’. Secondly, the presence of the digital open badges has a positive impact on attendance levels. According to her, students will attend when they have aspirations to acquire the digital open badges. She associates attendance with engagement and sees the digital open badges as a way to foster a culture of attendance. The digital open badges offer a talking point around attendance, creating a positive way to converse about attendance between staff and students and within the staff group according to the institute manager: ‘I think for the department to have that sort of collegial approach between staff, students and between students and their peers is really important to the department culture.’ Thirdly, the institute manager holds a positive view about the digital open badge associated with attendance, arguing that these badges provide an incentive to attend. This would have two effects according to her; it would encourage students

contemplating non-attendance to attend and it would give brighter students that feel they do not need to come to class in order to pass a reason to attend. This last point is important to the institute manager, as the presence of brighter students in class has a positive influence on others:

‘We have some very good students who are going to pass anyway. But had they actually been attending, they would have been a very good support to everybody else, and maybe challenge the lecturers a bit ...which would help the whole class learn.’ (Institute manager)

Expanding the digital open badge scheme to other programmes may initially meet resistance, particularly with older members of staff or those members of staff who would view the scheme as additional workload, according to the institute manager. However, she feels that demonstrating a link between digital open badges and increased attendance would be sufficient to convince staff to incorporate them.

4.7 Conclusion

Year 1 and Year 4 students, lecturing staff, an institute manager and an employer participated in the Phase 1 study. The aim of Phase 1 was to address Research Question 1:

RQ1: What role do key stakeholders - students, staff, management and employers - see for digital open badges in teaching and learning within the higher education sector?

Using a variety of methods (survey, learning journals and interviews), several roles were identified (section 4.2.4) which informed the development of the ‘Starter Pack’ of digital open badges. This ‘Starter Pack’ is the primary output from Phase 1 and is the focus of the investigation carried out in Phase 2.

In Phase 2, Year 1 students, an institute manager and an employer participated in the study. The focus of Phase 2 is to address Research Questions 2 and 3:

RQ 2. What processes and practices enable participatory digital open badge use by students and teachers?

RQ 3. How do digital open badges impact on learning, learner motivation and engagement and institutional teaching processes?

In Phase 2, Year 1 students on the Computer Aided Design module participated in two online surveys, one at the commencement of the module (September 2017) and the second at the conclusion of the module delivery (April 2018). In the intervening time, the students were eligible to apply for a number of digital open badges if they met certain criteria (for example, 100% attendance, high performance in an assessment and/or through peer nomination). After the module delivery concluded, four students volunteered to participate in semi-structured interviews, aimed at exploring their views of the digital open badge scheme. To address issues emerging from the student interviews and to offer overall reflections on the digital open badge scheme implementation, further interviews took place with two other stakeholders; the institute manager and the employer.

The Phase 2 data analysis set out to investigate whether relationships exist between several factors. CAO Entry Points have a medium ($r=0.442$, $p<0.05$) relationship to Final Grade. CAO Entry Points have been shown to have no significant relationship (i.e. $p>0.05$) between number of digital open badges earned. Therefore CAO Entry points may be useful in predicting final grade, but not the number of digital open badges.

There is a large relationship ($r=0.507$, $p<0.05$) between Final Grade and number of digital open badges earned in this study. A correlation of $r=0.524$ ($p>0.05$) suggests a large relationship exists between Overall Attendance and Final grade. There is no significant relationship between attendance and number of digital open badges earned.

In terms of changes to motivation over the course of the implementation of the digital open badge scheme, the level of motivation is seen to have increased using the intrinsic motivation index measure. All three categories (value/usefulness, perceived choice and interest/enjoyment) show increased levels at the end of the module delivery. The interest/enjoyment category shows a significantly higher level of increase, and it is argued that this is due to the digital open badge scheme adding an enjoyable aspect to the module which made it more interesting for the students; the presence of 'Mystery' badges, in particular, added intrigue to the

learning environment. The type of motivation showed little change, as measured using achievement goal theory. From the outset (pre-delivery survey) the type of motivation most prevalent for the students was intrinsic, and that did not change in any significant way over the course of implementing the digital open badge scheme.

While the data suggests that the students are generally favourable towards gaming mechanisms, there are mixed views on both the leaderboard approach and the sharing of progress with others. This corresponds to mixed views towards leaderboards seen in Dominguez et al. (2013), although Markopoulos et al. (2015) suggest that leaderboards are motivational, so further investigation is required. Almost all students agree to some extent that being able to see their own progress is important to them, but there is a reluctance to share this with others.

Almost all the students had no prior awareness of digital open badges before the pre-delivery survey. Even so, the responses at that point were still positive towards the usefulness and level of interest in digital open badges. At the pre-delivery stage, the students reported less interest in peer-issuing digital open badges compared to at the post-delivery stage. This reflects a change which warrants further investigation. The students express strong agreement that digital open badges should be awarded to anyone reaching a certain level of proficiency, not just the top grade scorer in the class. This point is reinforced by responses in the post-delivery survey, where we see that even more students are now in favour of more widely available digital open badges. Overall there seems to be a preference for knowing about all the digital open badges and how to earn them in advance: this could reflect the findings of McDaniel et al. (2012) where they report that hidden digital open badges can lead to frustration.

Resulting from the literature review, the Phase 1 study and the analysis of the Phase 2 study survey data, a set of interview questions was developed to explore uncertainties/ambiguities that were identified. The interview questions have been presented in this chapter, with findings outlined in terms of describing how the interviewees responded to each question. There was commonality within the responses, which formed the basis for thematic analysis of the transcripts. This analysis resulted in the identification of five themes: the learners have negotiated

meanings and values of digital open badges, the learners have an emotional response to earning digital open badges, earning digital open badges has an influence on learner behaviour, the learners have views on future implications of the scheme, and digital open badges encourage peer learning activities. Phase 2 interviews with institute manager and employer added further viewpoints around the meaning and value of the digital open badges, particularly in relation to clarification of the interpretation of the 'Level-up' badge, the value of the badges to employability and the aspects of the digital open badge scheme to be considered in future implementations.

Chapter 5 Discussion

5.1 Introduction

This chapter focuses on the discussion of both the quantitative and qualitative findings as presented in the previous chapter. In this section these findings will be discussed in terms of how the quantitative and qualitative analysis intersect with each other and other research in the field. The section is framed around the three central research questions of this thesis:

RQ1. What role do key stakeholders - students, staff, management and employers - see for digital open badges in teaching and learning within the higher education sector?

RQ2. What processes and practices enable participatory digital open badge use by students and teachers?

RQ3. How do digital open badges impact on learning, learner motivation and engagement and institutional teaching processes?

5.2 The roles of digital open badges in higher education

Given the multitude of roles for digital open badges found in the literature, finding a shared understanding of the roles is a challenge. Research Question 1 aims to address that challenge. There are three roles for digital open badges, according to Ahn et al. (2014). These are as a motivator of behaviour, as a pedagogical tool and as a signifier that might link economic and social opportunities. Another role is presented by Knight and Casilli (2012), who say that digital open badges can play a significant role in capturing learning that currently goes undetected in the traditional teaching approach. Furthermore, Cross et al. (2014) identified ten roles for digital open badges. In the simplest of terms, however, the digital open badge plays the role of a communication device. Mewburn (2017) argues that the communication role of the digital open badge relies on a shared common meaning amongst the actors involved.

The Phase 1 stage of this research found that the roles for digital open badges identified by the stakeholders align with some of those found in the literature: digital open badges are viewed as a way to increase motivation, to foster

community-building, to recognise non-academic as well as academic performance, and as a communication device for wider sharing. As an example of putting the community-building into action, the stakeholders taking part in the research were each willing to engage with designing a scheme of digital open badges. By including the stakeholder groups, a collaborative approach has been taken. Such a collaborative approach goes some way towards addressing the challenge of negotiating a shared common meaning for the roles of digital open badges. This aligns with a user-centric approach such as that in Haaranen et al. (2014), where it is argued that ‘by designing badges, learners can participate in designing learning goals’ (p. 41). The collaborative approach taken in this thesis was chosen to facilitate an inclusive negotiation around the design of the badge scheme and to avoid a top-down design of the intervention, such as that taken in Reid et al. (2015).

The primary outcome of this approach was the development of the ‘Starter Pack’ of digital open badges, which then became the focus of the Phase 2 study. A second outcome of the collaboration approach was the ‘Best Mentor in Class’ digital open badge which was developed in conjunction with the employer.

The findings of the Phase 2 study fall into five themes, and these have been synthesised into the following eleven roles for digital open badges identified by the students:

- increases engagement and motivation (e.g. the students indicated that the 100% Attendance badge encourages attendance, and that the reward of badges for assessment performance motivates to increase effort to obtain them)
- maps progress (e.g. badges issued for assessment performance and levelling-up, which the students view as useful for self and other consumers)
- generates interest in the module (e.g. the ‘Mystery’ badges added intrigue)
- reassures ability (e.g. the ‘CAD Buddy’ badges reassure the earner that they are able to use the software well enough to help their classmates)

- indicates potential to perform better (e.g. the ‘Improver’ badges signal an increase in ability which the students said would encourage them to maintain effort)
- proves capability in areas that a grade cannot capture (e.g. the ‘CAD Buddy’ badge is seen by the students as demonstration of communications, teamwork and mentoring abilities)
- signifies prestige (e.g. where a badge is awarded to a small number of recipients)
- proves reliability (e.g. the ‘100% Attendance’ badge is seen as verification of commitment and engagement)
- marks respect from peers (e.g. receiving a nomination for a ‘CAD Buddy’ badge is seen as a mark of respect by the students)
- encourages altruism (e.g. the willingness to help classmates is encouraged by the ‘CAD Buddy’ badge)
- provides a confidence boost (e.g. the students provide many examples of where receiving a digital open badge has given them a confidence boost, particularly in relation to performance in assessments)

There is also strong evidence that these roles are supported by views expressed in the Phase 2 surveys. For example, in the pre-delivery survey, 83.7% of the students agreed to some extent that seeing their progress is important to them, and 89.2% agreed to some extent that levelling-up provides a sense of progress. So, the roles of digital open badges identified in the interviews relating to improving and marking progress can be said to be important to a majority of the students. At the post-delivery survey stage, 54.0% of the students agreed that the digital open badges increased their motivation in the CAD module. Here we see that although there are clear reasons given at interview stage for how and why the digital open badges were motivational for the four interviewees, we cannot say that the digital open badges played the same role for all learners.

Further roles emerged from the Phase 2 interviews with the institute manager and employer. These are:

- vehicle for cultural change (e.g. the badges for attendance in particular)

- preparedness for continual professional development (e.g. the self-reflection needed to earn the ‘Level-up’ badges)

The institute manager suggests that the presence of digital open badges for attendance creates a culture of attendance that benefits the wider department by providing a conversation piece for staff around issues of attendance. This is important because at present there is no formal policy on attendance in the institute and the conversation tends to focus on the negative: informing students about the downsides of non-attendance. The institute manager views the digital open badges for attendance as an opportunity to re-focus the conversation by rewarding good attendance. She did offer caution, however, in the sense that if a student misses a class or two and is no longer in the running for a ‘100% Attendance’ digital open badge, then such a badge is unlikely to make the student re-engage.

The role that digital open badges play in signposting progress was highlighted by the employer. He saw the value in the digital open badge scheme as a mechanism for creating a culture of self-reflection and recognising the work ethic that aligns to qualities desired in the industry. For example, he equated the digital open badge scheme with the type of roadmap that is essential for continuing professional development (CPD). This reflects the role for digital open badges within professional practice seen in Diaz (2013) and Dyjur and Linstrom (2017), although it goes further: in this case the digital open badges are not sited in professional practice, but the employer has recognised that the scheme promotes and encourages students to engage in activities that prepare them for CPD from an early stage.

Although the civil engineering programme aims to prepare the graduates for certification with professional bodies based on several technical criteria, the digital open badge scheme is unique in that it offers preparation for the CPD process itself. Some of the non-technical criteria used by the accrediting professional body (Engineers Ireland) to certify the civil engineering degree (e.g. ‘ethics’) are difficult to demonstrate within the traditional assessment methods used. Digital open badges offer an alternative pedagogical tool for recognising and micro-credentialing such aspects of the programme.

5.3 Processes and practices that enable stakeholder participation in the use of digital open badges

This section addresses Research Question 2. ‘Participation’ here refers to taking part in activities where a shared willingness to accomplish a common goal is exercised through collaboration (Dominguez, 2012). This collaboration among the stakeholders is enacted through research and operational activities. Table 5.1 below shows the participation by each stakeholder. The students are unique participators in that they are the only stakeholder group eligible to earn the digital open badges on the scheme.

Table 5.1 Stakeholder participation activities

Stakeholder	Research activity	Operational activity
Students	Influence at design stage Reflection post-delivery	Earning and nominating badge issues
Lecturing staff	Influence at design stage	
Institute Manager	Influence at design stage Reflection post-delivery	
Employer	Influence at design stage Reflection post-delivery	Sponsorship of Best Mentor badge

The common goal is the improvement of the learning environment and increased learner motivation plays a critical role in this. If digital open badges are seen as a means of motivation, the question then arises: whose role is it to generate this motivation in the first place? There are three key stakeholders who could make a contribution to generating motivation: teachers, learners and employers. There is some debate in the literature around the involvement of these stakeholders, and where the emphasis should lie when designing a digital open badge scheme. For example, Buckley and Doyle (2016) and Crosling et al. (2009) contend that learner motivation should be driven by the teacher, while Hegarty (2011) and Santos et al. (2013b) argue this has to come from the learners themselves. With such diversity of views, perhaps an open approach to designing a digital open badges scheme, where the views of all stakeholders are considered, would be sensible. The reason why this approach was chosen was to avoid a top-down

approach to designing and implementing the digital open badge scheme. The risk with taking that type of approach is that the designer will include or omit digital open badge types based on their own judgement and not in consideration of what other stakeholders want from the implementation. We see such an approach in Reid et al. (2015), where the digital open badges trialled were linked directly to learning outcomes in a module. In that case, Reid et al. (2015) controlled and limited the type of digital open badges on offer, and were not able to show a significant increase in intrinsic motivation over the trial period. In this thesis, the participation of stakeholders at the design stage resulted in identifying roles for digital open badges beyond simply aligning them to module learning outcomes. This process afforded control and ownership to the stakeholders and it resulted in the development of the ‘Starter Pack’ of digital open badges.

The practices which enable participation are:

- Consulting with all stakeholders at the design stage. For example, the Phase 1 surveys, journals and interviews lead to the development of the ‘Starter Pack’, and consultation with the employer resulted in the ‘Best Mentor in Class’ badge.
- Consulting with students before and after implementation. This sets the scene for the students by introducing them to the digital open badge scheme, facilitates the measurement of changes in motivation and attitude, and allows students the opportunity to reflect on the scheme and provide feedback.
- Ensuring all students have an opportunity to obtain at least some digital open badges. Digital open badges were included in the ‘Starter Pack’ which all students were capable of obtaining. For example, the ‘Improver’ badges were available for those showing progress in assessments even if the assessment submissions were not to a high quality. Similarly, the ‘Level-up’ badges were available to any student making a second (and better) attempt at an assessment. Other badges (e.g. the ‘CAD Buddy’ and ‘100% Attendance’ badges) were not related to technical proficiency as such, and so any student could potentially earn them. Only three digital

open badges out of the seventeen in the scheme (i.e. the ‘Best in Class’ ones) were obtainable by a sole recipient.

- Allowing students to make nominations for peers to earn digital open badges. Based on the Phase 2 survey responses and student interviews, there are clear views on the benefits of this for the students. By including nominations in the scheme, it affords a level of control over some of the digital open badges for those wishing to nominate. It also gives those students a mechanism to recognise and reward their peers.
- Including of a variety of digital open badges that can be earned for a range of actions. The digital open badge scheme contains badges that can be earned in a variety of ways, rather than being based solely on, for example, assessment performance. By including a variety of earning mechanisms, the students can set their own goals and expectations and aim to earn the digital open badges that they value most.
- Affording control to the students. The students have control over who is awarded the ‘CAD Buddy’ digital open badges, they also have control over which badges to aim for and what they do with the badges when they have earned them. This facilitates a degree of ownership for the students.
- Modifying the scheme based on feedback. The students in Phase 2 understood the scheme (having experienced it) well enough to offer suggestions for future implementations of it. For example, there is a strong argument for making some of the ‘Mystery’ badges visible instead of hidden. This is particularly the case for those associated with attendance, where the students reported that knowing about these badges in advance would encourage greater attendance at class. This practice of acting on feedback can be considered as closing the loop back to the first practice listed above, namely consultation with stakeholders.

Enabling participation while operating the scheme centres on two factors: giving the learners a voice and giving them a level of control. Firstly, in this thesis, the student voice during the implementation of the scheme is evident in the surveys and the interviews. In both instances, the students were afforded opportunities to influence the design of the scheme, before and after taking part in its delivery. The

benefits of including the students in the role of designers are seen in Haaranen et al. (2014) and Laanpere et al. (2014). On conclusion of the module delivery, the students were able to express overall satisfaction with the range of digital open badges that were available in the scheme, but they voiced suggestions for changes to the operation of the scheme for future implementations. This shows that they are confident enough in having experienced the digital open badge scheme and that they are able to see how it can be improved. An outcome of this is the views of students can be considered and incorporated in any modification of the scheme (with the assumption that this will be an improvement) before being used again.

Secondly, allowing the students have a level of control is an important factor in promoting participation. This thesis shows that the earners are making decisions about whether to claim digital open badges, and how to use them. Prior to the Phase 1 and Phase 2 pre-delivery surveys, a short video introduction was shown to the participants; this gave the students an initial concept of what digital open badges are and how they can be used. After the Phase 2 pre-delivery survey, at the beginning of the implementation, instruction was given to the students regarding the use of the software platforms to claim digital open badges earned and for making peer nominations. During this process, there is a risk of either implicitly or explicitly influencing the views of the students. However, care was taken to ensure no 'top-down' instruction was given which would limit the students' perceptions. This allowed the students to form their own views to how to deal with the digital open badges, and their own meanings and values in relation to which ones to claim and which ones to share. This aligns with an open interaction between peers and instructors for implementing a digital open badge scheme, as advocated by Williams et al. (2011). In addition to affording a level of control in how the students can influence the design of the scheme and interact with the digital open badges, the inclusion of peer-nominated digital open badges allows the students to become participants in awarding digital open badges. Myllymäki and Hakala (2015) identify the reporting of hidden learning as a challenge that digital open badges can address, but they do not offer any insight into how to capture this hidden learning. The institute manager suggested that peer learning is essential for creating a positive learning environment, and that digital open badges encourage such activity. Although a comparison with previous attitudes towards

peer learning in the civil engineering programme is not possible, this thesis contends that the operation of the peer-nominated CAD Buddy digital open badges has provided a mechanism for capturing such hidden learning by which comparison can now be realised. Prior to the introduction of digital open badges through this research, no such mechanism existed either on the programme or more broadly within the Department of Civil Engineering.

Not only have we seen in the interviews that the students value being able to nominate and getting nominated, but the pre- and post-delivery surveys also support a change in attitude over the course of the delivery of the scheme. Before the delivery of the module and digital open badges, 27.0% of the students agreed that they would like to issue badges. 'Issuing' here means the process of nominating a peer for award of a digital open badge. By the end of the module, 67.6% agreed that they liked being able to issue digital open badges. Similarly, before delivery, 32.4% of the students said that they would like classmates to issue digital open badges to them. After delivery of the scheme, 59.5% agreed that they liked classmates issuing digital open badges to them. See Figure 5.1, below.

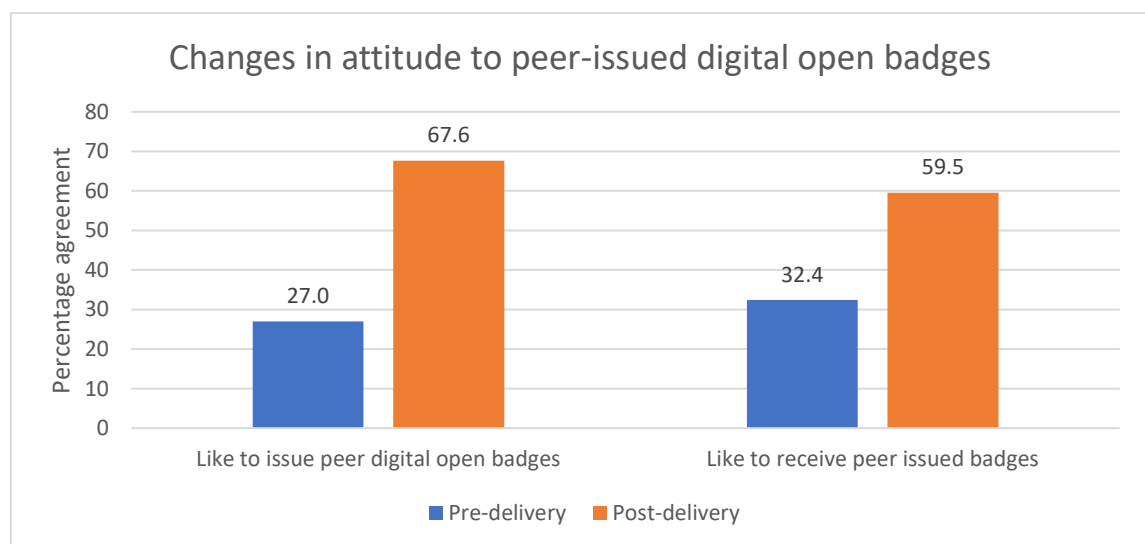


Figure 5.1 Changes in attitude to peer-issued badges over the course of delivery

Here we have clear evidence that the practice of including peer nominations has resulted in a change of attitude, where students are now more favourable to digital open badges that they have control over. Not only do they have control over who

they nominate, they have control over defining their own criteria for what constitutes a good reason to nominate.

The focus of participation outlined above is on the learner. However, the practices piloted also help enable participation by the employer (see for example Section 4.2.3 and Section 4.6). There are two roles that the employer has taken on in this study. Firstly, the employer has acted as a consultant at the design stage of the digital open badge scheme, where qualities and traits identified as important for employers (i.e. mentoring) were incorporated into the scheme. Secondly, the employer has demonstrated support for the scheme by sponsoring the ‘Best Mentor’ digital open badge and offering the additional reward of a day as a guest in the design office to the recipient. This adds credibility to the digital open badge scheme, something that O’Byrne et al. (2015) claimed was a challenge. In addition, such sponsorship presents an opportunity for two stakeholders; the students benefit by getting an early insight into the design career path, and the employer benefits by the early identification of students which they would be interested in employing.

5.4 How do digital open badges impact on learning, learner motivation and engagement and institutional teaching processes?

This section relates to Research Question 3, which is the most critical question to answer, as the thesis is based around investigating a way to increase learner engagement and motivation. This research question has three parts; the impact on learning, the impact on motivation and engagement, and the impact on teaching practice. Each of these is addressed separately in this section.

5.4.1 The impact on learning

This thesis has highlighted several ways in which learning has been impacted as a result of the delivery of the CAD module with the digital open badges incorporated. These are through the encouragement of peer learning and deep learning, and the impact on grades.

The thesis does not make the assumption that peer learning would not have happened without the digital open badges, but there is clear evidence that this type

of learning is both recognised and encouraged by the operation of the digital open badge scheme. This has been shown to not only reward those leading the peer learning, but there is also an explicit view that this also helps students that might be having difficulties with the module material. An additional facet to this is that digital open badges available through peer nomination have the effect of putting the students in control over who gets certain badges. Deep learning is also taking place as a direct result of the digital open badge scheme, with students saying that they worked harder on finer details in an attempt to obtain a digital open badge. For example, in the Phase 2 interviews, Student 2 explicitly said that the presence of the digital open badges (and specifically his desire to earn them) made him put in extra effort to get better grades in assessments.

The type of learning supported by the digital open badge scheme extends beyond that related to curriculum. We have seen how the employer values the scheme as a mechanism for promoting the culture of continual professional development; a desirable trait for employability and career progression that is enabled and recognised through the digital open badges scheme. The employer highlighted the role of self-reflection and the need for a proactive approach to self-improvement as essential for the civil engineering professional. The digital open badge scheme, and in particular the 'Level-up' badges, support this type of activity and add value to the student learning experience. In the Phase 2 student interviews, three of the participants associated the 'Level-up' digital open badges with traits that they perceive as being valuable when seeking employment. The other student interviewee did not see the 'Level-up' digital open badge as something he would share with potential employers, but he did see a value in that badge in terms of how it is worth trying to obtain because of the confidence boost it would give. There are, then, two benefits for trying again at assessments, and these centre on demonstrating improvement (either to self or to potential employers). The impact of the 'Level-up' badge on learning is that it encourages self-reflection which leads to improvement. In this sense, it provides a framework for the students to enact Kolb's experiential learning cycle (Kolb, 1984).

A large relationship between final grade and number of digital open badges has been found. This is linear in nature, with those students earning a higher number of digital open badges also achieving higher grades. This relationship considers

digital open badges earned for non-graded activities only (i.e. for attendance, for peer nomination and for levelling-up). This highlights the importance of including digital open badges for actions and behaviours that go beyond a simple alignment to learning outcomes and/or assessments.

5.4.2 The impact on learner motivation and engagement

A central aim of this thesis is to investigate whether digital open badges can act as a device to increase learner motivation and engagement. Motivation is complex and depends on whether the learner expects to perform well or not, according to Reid et al. (2015). What we have seen in this thesis is that obtaining digital open badges has had the effect of raising the performance expectation of the students: when they get a digital open badge for improving, for example, they have the confidence that they can continue to improve. Jovanovic and Devedzic (2014) argue that there is potentially a link between digital open badges and motivation. The findings of this study suggest that while there is clear evidence that such a link does exist for the students interviewed, the analysis of the survey data suggests that the presence of the digital open badge scheme did not have an overall impact on the type of motivation of the class as a whole. This may be because the students were already reporting relatively high levels of intrinsic motivation measured using achievement goal theory at the pre-delivery stage (when compared to levels reported by Elliot and Church, 1997), and so no significant increase was observed. With a mean score of 6.086 (pre-delivery) and 6.014 (post-delivery), the skills-mastery approach is the most prevalent in the students. Elliot and Church (1997) link this approach with intrinsic motivation. Both other categories (particularly the performance-avoidance approach) are linked with extrinsic motivation. The responses here show that the student participants are more strongly intrinsically motivated than extrinsically.

Similarly, the survey data suggests that when measured using the intrinsic motivation index (IMI), the students began the module with relatively high levels of intrinsic motivation (compared to levels reported by Deci et al., 1994). In contrast to the achievement goal theory measure, however, the students did show an increase in motivation over the course of delivery of the module when measured in terms of having choices and having interest/enjoyment in the module. In increase in terms of perceived choice is not significant, although we see in the

interviews that the students have been in control of making choices around the digital open badge scheme (i.e. choosing to claim, to share, to nominate, to attend and to work harder), and so it is argued that this is the reason why motivation based on perceived choice has increased to some extent.

A significant increase in motivation level in the category of interest/enjoyment was found. The students have said that certain digital open badges (particularly the ‘Mystery Badges’) added intrigue and interest to the module. In the post-delivery survey 86.5% of the students said that they liked earning digital open badges, and during the interviews it was clear that the students enjoyed aspects of the implementation of the scheme. This explains why the motivation level due to interest/enjoyment increased significantly over the delivery of the module.

The approach taken in this study is similar to that taken by Deci et al. (1994) in its use of the Intrinsic Motivation Index (IMI). Figure 5.2, below, shows the results reported by Deci et al. (1994) in their study. In Figure 5.2, “rationale” means that Deci et al. (1994) explained to their students that the tasks being carried out by them are useful, and “no acknowledge” means they did not tell the students that the task might be considered boring. It is these “no acknowledgement” means that can be compared to the approach taken in this study, as the students in this study were given no indication that the module might be considered boring. Deci et al. (1994) also used control groups in their study, and the column on the right in Figure 5.2 represents students who were told they “had” to do certain things and behave in certain ways (i.e. the language used offered less choice). It is this column (outlined in Figure 5.2) which offers the best comparison to the current study.

<i>Rationale</i>			
Acknowledgment	Choice	5.01 (0.69)	3.91 (0.96)
	Usefulness	3.66 (1.08)	3.12 (1.11)
	Interest/enjoyment	2.65 (1.01)	2.12 (0.86)
	<i>n</i>	48	16
No acknowledgment	Choice	4.97 (0.98)	3.85 (1.04)
	Usefulness	3.49 (1.23)	3.81 (0.79)
	Interest/enjoyment	2.88 (1.42)	2.71 (0.92)
	<i>n</i>	16	16

Figure 5.2 Mean values in Deci et al. (1994, p. 133)

Deci et al. (1994) contend that intrinsic motivation can be measured by internalisation and self-regulation, with higher scores meaning higher levels of same. Using that measure, the data analysis suggests that students in the current study show comparatively high levels of intrinsic motivation. In the post-delivery survey, the mean for interest/enjoyment significantly increased compared to that at the beginning of the year, from 5.842 to 6.018 respectively. Cronbach's α values for this category at the pre- and post-delivery stage were found to be .847 and .846, respectively. These findings are comparable to those in Amarose and Horn (2001), where pre- and post-scenario mean values of 5.95 and 5.88 for the interest/enjoyment category value is interpreted to mean a high level of intrinsic motivation exists. Amarose and Horn (2001), report pre- and post-scenario Cronbach's α values of .74 and .89 in relation to reliability.

During the interview stage of the Phase 2 study, it was clear that all four students interviewed were reporting an increase in motivation due to the presence of the digital open badge scheme. This ranged from motivation to improve on academic performance, to earn prestige by performing better academically than everyone else in the class, to work harder to get certain digital open badges, to gain the respect of their peers, to get a confidence boost, and to form links to employability.

'Engagement' in this thesis is taken to mean two things: attendance at class and an interest in the module. From the interviews, we can see that students view the 100% Attendance digital open badges as valuable evidence of reliability to

present on a CV and are something which they desire to obtain. These digital open badges were implemented as 'Mystery Badges', and there is clear evidence to suggest making these badges visible from the start of the module would have had the effect of changing the behaviour of students, to increase their attendance at class. The 'Mystery Badges' also added intrigue and interest to the module. This is seen as a positive feature of the digital open badge scheme used. The students reported that not knowing what the 'Mystery Badges' were going to be awarded for kept them interested in engaging with the module. The Phase 2 survey supports this view, as the 'interest/enjoyment' category of the Intrinsic Motivation Index shows a significant increase between the start and end of module delivery. This finding is important, as it aligns with Moley et al. (2011), where it is argued that interest in a topic is a driver for engagement.

In the survey data, we have seen an increase in the positivity towards peer nominations for digital open badges. This relates to digital open badges available for peer learning activity, an act of engagement with the module that goes beyond the classroom. This increase in positivity is supported by the evidence in the interviews, where the students have assigned meaning and value to the peer nominated digital open badges, to the extent that they value them more highly than any other type of digital open badge. The value is that this type of digital open badge provides evidence for the earner of skills and traits that would not normally get recognised in a useful way. The students see peer nominated digital open badges as representing respect from their classmates, a view shared by the employer in the Phase 1 study.

5.4.3 The impact on institutional teaching practice

There are three impacts that digital open badges have on teaching practice: they can increase attendance and interest in a module, they make peer learning more visible, and they offer a form of feedback that has longer-term value proposition for the student. We see in Romer (1993) that there is a relationship between attendance and academic performance, with regular attenders achieving higher grades than sporadic attenders. Therefore, Romer (1993) argues, institutes should take steps to increase attendance. In this thesis, attendance over the academic year was recorded and tested against final grade. A correlation of 0.524 was found, suggesting a large relationship between attendance and final grade. It is clear,

then, that teaching practice should aim to maximise attendance levels. This would lead to higher grades for the students, and would also facilitate more efficiency for teaching practice by minimising the need to repeat points made in previous lectures. There is strong evidence in the interview data that the availability of digital open badges would motivate students to attend. The issue of attendance was highlighted by the institute manager, where it was suggested that poor attendance causes problems for student progression and that actions to improve attendance are to be welcomed. In addition to encouraging weaker students to attend, incentivising attendance would have the effect of giving the brighter students a reason to attend, particularly if they are in a position where they feel they can pass without attending. The presence of these students would have a positive impact in the learning environment. This echoes the view of Iosup and Epema (2014) that attendance and quality will drop without the presence of high achievers. Therefore, there is a strong case for including digital open badges for attendance, to benefit both the learners and teaching practice.

Digital open badges capture not only hidden learning, but peer learning. This type of learning puts social constructivism into practice, with the students in control of how they construct and negotiate ways to help each other. Not only are the students negotiating ways to help each other, they are making their own decisions about whether to nominate each other for a 'CAD Buddy' digital open badge. This affords two actors (i.e. the helper and the helped) a level of control over how the digital open badge scheme compliments their learning experience. The students are in control over who they consider worthy of a nomination, and why. This allows them to reflect on the peer interaction and make a value judgement on whether making a nomination is appropriate. When students are willing to engage in peer learning, it has the benefit of ensuring students needing help have an additional avenue for getting it other than asking their lecturer. If the lecturer is engaged with a digital open badge implementation where they can see and verify peer learning in action, this can inform their approach to teaching: particularly if the learners have negotiated a new meaning or way of explaining a concept which can be later be considered for use by the lecturer. This demonstrates how digital open badges can foster a collaborative approach to teaching and learning. Further collaboration, this time between staff members, would be enabled with a

broadening of the digital open badge scheme to other modules/programmes, as this would initiate conversations around how the badges could be used. There may be challenges to such broadening, such as some staff members perceiving the scheme as extra workload. However, the institute manager holds the viewpoint that once the benefits of digital open badges (particularly those linked to high attendance) are made clear, there would be a willingness by staff to adopt such a scheme.

Feedback (both formative and summative) tends to centre on performance in academic assessment, and so makes no accommodation for informal performance relating to aspects such as attendance and peer learning. As such, the feedback may only have an immediate and short-term effect at the time of receipt. To enhance this, the transparent and detailed feedback offered by digital open badges has a positive impact on learner engagement, according to Devedžic and Jovanovic (2015). This is supported by the interview data, where students reported increased confidence and desire to perform well as a result of obtaining digital open badges. However, not every student in the class claimed digital open badges, but many were still in a position to pass the module. This demonstrates that while some students benefitted from the added value of the detailed feedback and confidence boost provided by the digital open badges, others were content to pass without engagement in the scheme as presented.

The institute manager also recognised that feedback usually happens for assessments only. She argued that the digital open badges offer a more continual engagement in communication between staff and students, leading to an improved learning environment. In addition, digital open badges offer something not normally associated with feedback: longevity. This research has shown how the students are planning for success with respect to how the digital open badges will be of use to them when seeking employment.

5.5 Limitations

There are several limitations in this case study. The first limitation is the configuration of the badge scheme itself: the implementation trialled one specific set of digital open badges. While this was based on previous research in the field and designed in collaboration with the stakeholders, the scheme used is just one

way in which digital open badges could be configured. The students expressed satisfaction with the number and type of badges presented, but further research and trialling of more/less/different badges would add greater certainty to what works best.

Another limiting factor is the narrow focus on one specific setting. While the interpretation of the survey and interview data can be considered appropriate for this setting, there is no claim being made for any generalisation of the findings to every other context. However, the findings are relevant to courses where practical skills that are clearly linked to industry are being taught. It is important both to the students and to the employer to design a digital open badge scheme where desirable graduate attributes (technical and behavioural) are recognised. The findings are relevant to the design of other digital open badge schemes where such an approach is being considered. The findings are also relevant where the student cohort contains learners at risk of non-progression where lack of motivation to attend is an influencing factor.

Not only is the research narrowed to one programme (i.e. Civil Engineering at the Galway-Mayo Institute of Technology), the impact of the intervention is further confined to just one cohort on that programme: first-year students engaged on the CAD module. The focus on that specific group was made with the intention of exploring an intervention that might affect an increase in engagement with the module, thereby potentially leading to better academic performance and an increase in retention rate. The participants were aware that the digital open badge scheme was a pilot project, but it has resulted in identifying positive attributes and impacts on the learning environment. There is a limitation raised here, insofar as the benefits presented in this case study only impact on one module and will become lost if the scheme is not broadened within the institute. This will have two effects; firstly, the motivational gain is unlikely to be present in other modules, and secondly the students may interpret a lack of digital open badges elsewhere as an indication that the institute does not value the scheme. The consequences of this limitation may be addressed by trialling a digital open badge scheme more broadly within the programme.

There is a limitation with respect to the single iteration used in the study; repeated iterations of the intervention across a number of years would yield more reliable results. For example, where the findings suggest recommendations for future implementation of the scheme, it would be desirable to action those and trial the scheme again. The use of A-B testing might also lead to further evidence of the effectiveness of the scheme.

While there were good completion rates with the student surveys during this study, the sample size is relatively small and this presents a limitation for the factor analysis used. The sample size was limited by the class size. The number of student interviews conducted is a further limitation. Triangulation with survey data goes some way to addressing this limitation, although including students around the average grade in the class would have provided a fuller spectrum of profiles in Phase 2. In total eight students were interviewed for this research, four before the implementation and four afterwards. While the number is relatively small, the approach taken allows for the presentation of viewpoints from before and after the intervention.

Similarly, one employer was chosen for interview. This is a limitation which was mitigated by conducting two interviews with this participant at different stages. This is an important mitigation, as it enabled the employer chosen to influence the design of the digital open badge scheme at an early stage, engage with it during the implementation and then reflect on it at the end of the trial period. Although only one employer took part, he was chosen as being typical of the type of employer that graduates from the programme would seek employment with. He represented a multi-national company with 5,200 employees across 125 countries. This employer has a track record of employing graduates from the Civil Engineering programme at the GMIT, and so has a good understanding of what graduate attributes/behaviours and accomplishments should be reflected in the digital open badge scheme.

5.6 Conclusion

This chapter has outlined a discussion around the findings resulting from analysis of data from the surveys and interviews with students, and interviews with institute manager and employer. The discussion centred on the three research

questions, and presented arguments for how the digital open badge scheme plays a role and has an impact for all stakeholders in the study. While it is clear that there are several interpretations of what digital open badges mean to the stakeholders, there is strong evidence that they play valuable roles in terms of increasing learner engagement and motivation, addressing institutional issues around attendance, and preparation for employment and professional development. A total of thirteen roles for digital open badges are presented in this chapter. These are shown in Figure 5.3, below.

- increases engagement and motivation
- maps progress
- generates interest in the module
- reassures ability
- indicates potential to perform better
- proves capability in areas that a grade cannot capture
- signifies prestige
- proves reliability
- marks respect from peers
- encourages altruism
- provides a confidence boost
- acts as vehicle for cultural change
- provides preparedness for continual professional development

Figure 5.3 Roles for digital open badges

The key practice which enables participation in the digital open badge scheme is collaboration with stakeholders. This chapter outlines seven actions that enact this collaboration, which happen at design stage, during implementation and by reflecting upon completion of delivery. These enablers are shown in Figure 5.4, below.

- Consulting with all stakeholders at the design stage.
- Consulting with students before and after implementation.
- Ensuring all students have an opportunity to obtain at least some digital open badges.
- Allowing students to make nominations for peers to earn digital open badges.
- Including of a variety of digital open badges that can be earned for a range of actions.
- Affording control to the students.
- Modifying the scheme based on feedback.

Figure 5.4 Enablers of participation in the digital open badges scheme

There are clear impacts on learning, learner motivation and institutional practice as a result of implementing the digital open badge scheme. Deeper learning and peer-learning are encouraged by the opportunity to earn certain digital open badges. The presence of digital open badges has motivated some students to work harder and to increase attendance at class. Increasing attendance is a desirable outcome for the programme and the department more broadly, and so there is institutional interest in that particular impact of the digital open badge scheme.

This chapter also outlines the limitations of the study. Some of these resulted from the practical limitation of the class size, and so further iterations of the digital open badges scheme with other cohorts are recommended to add reliability and to verify the effectiveness of the intervention.

Chapter 6 Conclusions

This chapter presents the overall conclusions drawn from the three research questions and the two phases of the study. The overall aim of the research is to investigate the impact of an intervention. This chapter discusses the ways in which the research informs stakeholders of the roles, values and impacts that digital open badges have for learners, teaching practice, the institution and employers. The implications of the findings and recommendations relating to the future design and implementation of a digital open badge scheme are discussed. Issues for further research areas are identified and the chapter then closes with personal reflections.

6.1 Conclusions

This study set out to answer the research questions through the design, implementation and evaluation an intervention aimed at improving learner motivation and engagement on the Computer Aided Design (CAD) module of the Civil Engineering degree programme at the Galway-Mayo Institute of Technology. Student retention rates are lower than the national level on this programme, and the institute seeks ways to address this (GMIT, 2015). One factor which influences retention is motivation (Assiter and Gibbs, 2007) and the aim of this research is to ascertain whether digital open badges have a motivational effect for students on the CAD module. The three central research questions are:

RQ1. What role do key stakeholders - students, staff, management and employers - see for digital open badges in teaching and learning within the higher education sector?

RQ2. What processes and practices enable participatory digital open badge use by students and teachers?

RQ3. How do digital open badges impact on learning, learner motivation and engagement and institutional teaching processes?

The first research question is addressed through engaging with students (surveys, interviews and learning journals) and other stakeholders (interviews with lecturing staff, institute management and an employer). The findings point to several roles with differing value propositions determined by the different stakeholders. Many

of these align with roles identified in the literature. For example, the three roles for digital open badges identified by Ahn et al. (2014) are also found in this study: as a motivator of behaviour, as a pedagogical tool and as a signifier that might link economic and social opportunities. These three roles are broad, and this research seeks to find specific and identifiable roles within the context of the civil engineering programme. The students identified eleven roles for digital open badges, and the institute manager and employer added further roles relating to departmental issues around collegiality and preparedness for continuing professional development. Thematic analysis of the student interviews has resulted in five themes related to digital open badges in the context of this research. The themes are: there are several meanings and values of digital open badges, there is an emotional response to earning digital open badges, digital open badges influence behaviour, earners of digital open badges can express views on future implementations, and digital open badges encourage peer-learning activity. All of these add insights in the context of the study, as digital open badges had not previously been trialled on any programme at the GMIT. The significance of the findings is that they demonstrate a shared interest in digital open badges across the stakeholders, as each can see how the digital open badges add value: the students see the badges as something that add interest and motivation, the institute manager values the badges in the context of encouraging attendance, and the employer sees value in the badges that reward the type of reflective thinking and work ethic that is expected for success in the workplace.

The second research question is addressed in Phase 1 when designing the digital open badge scheme and in Phase 2 during the implementation. In Phase 1 this takes the form of consultation with the various stakeholders prior to developing the ‘Starter Pack’ of digital open badges which were then trialled in Phase 2. Participation was enabled in the Phase 2 stage primarily for the students; they engaged in the process by influencing the design of the scheme, by earning digital open badges, by nominating peers for award of digital open badges, and by exercising decision-making about how the digital open badges align with their plans for success. This approach worked, as the students reported a sense of involvement with both the design and the operation of the digital open badge scheme. Further participation with institute management and employer was also

enabled in Phase 2. Both stakeholders undertook a reflection on the digital open badge scheme, and the employer went further by actively engaging in sponsoring an additional reward associated with the 'Best Mentor' digital open badge. The involvement of the employer in Phase 1 and again in Phase 2 means that the employer has played a role of design and evaluation in this research. This longitudinal involvement of employer is rare in the literature around digital open badges, and this thesis offers a significant addition to prior knowledge in this area. This points to an inclusive approach, where stakeholders had an input to the digital open badge scheme at various stages. Both the institute manager and the employer expressed interest in continued involvement in the digital open badge scheme, and so the inclusive approach proved beneficial. A total of seven enablers for participation have been identified in this thesis. Using these enablers, all stakeholders have been given a voice to express their views on what they expect from a digital open badge scheme. However, the students are the stakeholder group most closely involved in the implementation, and so the enablers go beyond collaboration in their case. For the students, the enablers represent clear mechanisms for active participation in the operation of the digital open badge scheme. The enablers presented are a good fit for the context of this study, although the final enabler (modification of the scheme prior to another iteration) remains to be tested.

The third research question is central to the thesis as it addresses the impact of the intervention. A mixed methods approach, combining survey data analysis with thematic analysis of interviews was used to measure and explore the students' experience of using or not using the digital open badges. Over the academic year in which the digital open badges were available, the type of motivation (intrinsic/extrinsic) did not show a significant change. A change was expected, as it was hoped that the digital open badges would impact motivation. It is concluded that no change in motivation type was observed because the students were already showing a relatively high tendency towards intrinsic motivation from the start of the year, and this was maintained throughout the implementation.

However, the level of motivation relating to perceived choice rose slightly and relating to interest/enjoyment rose significantly over the academic year. This aligns with the student interviews in Phase 2, where the students report making

choices about how they interact with the digital open badges, and where the inclusion of the digital open badge scheme has made the module more interesting for the learners. There are several ways that the digital open badges enable choices for the students:

- The presence of digital open badges linked to high performance in assessments has led to some students choosing to put extra effort into preparing for assessments, with the specific aim of achieving those badges. In this case, the digital open badges are providing an incentive for deeper learning (not settling for the bare minimum to pass). This type of activity could happen for some students in any case, even if digital open badges were not on offer. However, the students have indicated that the confidence boost and potential for future use of the badges provides motivation to perform well.
- The ‘Level-up’ digital open badges are associated with a second attempt at some tasks. The students taking on this optional extra work are making a choice about their own learning, where they can see a value in terms of skills mastery. This particular type digital open badge was favoured by the employer, so its inclusion in the scheme has high value.
- The students can make choices around peer learning. They can choose to help each other, and they can choose to nominate each other for the ‘CAD Buddy’ badge. Again, peer learning may happen irrespective of the digital open badges, but the recognition of this with a digital open badge presents an incentive to choose to engage in this type of learning. This is central to promoting collegiality, and is a desirable outcome according to the institute manager. This is something that has not previously been rewarded within the programme, and so the digital open badges offer a unique way to recognise when peer learning happens.
- The students are making choices around the dissemination of the digital open badges earned. They have reported using the badges on their CV, and have identified the role that digital open badges can play in planning for future success. It is insightful that one student associated a negative connotation with the ‘Level-up’ digital open badge and reported that he

has chosen to not share that badge with prospective employers (even though he has identified a benefit for himself in earning that badge).

- The digital open badges are linked to choices around behaviour, specifically attendance. Students have stated that the presence of digital open badges as a reward for high attendance would influence their decision to attend class. This is seen as important to the institute manager, as there is currently no other mechanism for rewarding attendance at the GMIT. Here again we see the digital open badges offering a unique way to promote and reward desirable student behaviour.

The influence of digital open badges in increasing motivation due to interest/enjoyment in the module is an important outcome, as the literature suggests that this type of module can be difficult for new learners (Li et al., 2012). They argue that new users find it difficult to become motivated to learn due to the large number of commands in the software, and suggest a gamified approach to deal with this issue. The approach taken in this thesis addresses that difficulty by providing a clear pathway (the ‘Starter Pack’) for the new user, so that the learning material is presented in a series of milestones which make progress easier to track. This thesis goes further than Li et al. (2012), as it also includes rewards that go beyond the technical learning difficulty. It does this by including ‘Mystery’ digital open badges which the students say added intrigue and interest to the CAD module. More broadly, 87.5% of the students in Phase 2 agreed that they liked earning the digital open badges with 54.1% agreeing that the badges increased their motivation on the CAD module.

The type of learning which the digital open badges encourage goes beyond engaging solely with the curriculum with a view to passing the module. The stakeholders involved recognise that the digital open badges offer a mechanism for signposting and rewarding peer-learning, self-reflective practice and attendance. The institute manager considers peer-learning to be valuable in terms of fostering a collegial culture among students, in addition to the academic benefit it brings. It is an important finding of this thesis, then, that digital open badges encourage and reward this type of activity within the class cohort. The employer views self-reflection as an essential quality for the professional civil engineer, and

one which is vital for career progression. This quality is encouraged and rewarded by the ‘Level-up’ digital open badges investigated in this thesis. The value of including this type of digital open badge in preparation for employment is clear, as the employer singled it out as being the most valuable badge from his perspective.

In addition to peer-learning and self-reflection, a further non-assessment based factor considered in the scheme is attendance. Institute management and students identify the motivational influence that digital open badges have on attendance levels. The students claim that the opportunity to earn digital open badges for attendance would encourage them to come to class. This is an important finding, as according to Romer (1993) good attendance is linked to good academic achievement. This is supported in this thesis where a large correlation between attendance and final grade was found. The institute manager also recognises the importance of good attendance for good academic performance, and considers the digital open badges to be a good way to encourage this type of behaviour. Further, the institute manager views the digital open badges as important for a broader discussion within the institute, as they offer a positive framework for promoting attendance.

This thesis not only shows the value and importance of the three non-assessment based activities within the digital open badge scheme investigated (peer-learning, self-reflection and attendance). It goes further, as in each of these cases, the digital open badges offer a unique mechanism for promoting and capturing these qualities and behaviours. Prior to this study in the Civil Engineering programme there was no way to encourage, recognise or reward students for these attributes.

6.2 Implications for practice

Several implications for practice emerged in this research when considering future implementations of a digital open badge scheme on the CAD module, and more broadly within the Civil Engineering programme and department. These relate to both the digital open badge scheme design in general, and to specific digital open badges within the scheme.

Firstly, to address the complex issue of negotiating shared meanings for the digital open badges, it is recommended that early engagement with all stakeholders at the

design stage is useful. The benefit of this process in this research, is that it not only lead to the development of which digital open badges to include in the scheme and why, but it had the added effect of increasing the awareness of what digital open badges are in the first place for the stakeholders. While some years have passed since digital open badges were described as new by Jovanovic and Devedzic (2014), prior awareness of them in the context of this thesis was very low. Students in particular had essentially no prior knowledge of digital open badges. Nor had the employer, but he was quick to recognise the role digital open badges can play in recruitment and continuing professional development. Due to this, taking the approach of early stakeholder engagement ensures that the scheme can be designed to incorporate digital open badges that these stakeholders will recognise and value more readily. The benefit of this approach in this case is that it produced digital open badges that are unique in reflecting non-academic qualities that the stakeholders had no previous means of capturing. Had the approach of early engagement with stakeholders in the design of the scheme not taken place, there is a likelihood that some of these digital open badges would not have been included in the trial.

Secondly, the value proposition to students and the institute emerging from digital open badges linked to attendance is such that this type of badge should be given increased prominence. There are two factors to consider for this. Firstly by making the digital badges for attendance visible from the start of delivery, and secondly by using them more broadly on the programme and department. There is a strong case for making digital open badges for attendance visible from the beginning of the academic year; in this research they formed part of a hidden set. The students have claimed that the presence and prior knowledge of digital open badges rewarding high levels of attendance will have the effect of incentivising and increasing attendance at class. Institute management held the same view but went further to suggest that digital open badges rewarding attendance will have a positive impact more widely across the department if implemented. This is because the digital open badges offer a positive conversation piece around attendance; discourse on attendance with students and staff has tended to focus on the negative impact of non-attendance. The digital open badges offer an opportunity to reward good attendance and focus on the benefits of attendance

rather than the drawbacks of non-attendance. The institute manager views attendance as an important part of engaging and retaining students, and values the role digital open badges can play in this regard.

Thirdly, in relation to the manner of earning digital open badges for attendance, in this thesis they were awarded for 100% attendance at the CAD module classes. The institute manager recognised a risk to this approach, namely that if a student misses a class and realises that they have no way to earn a '100% Attendance' digital open badge, they no longer have that incentive to attend. The implication of this is that their attendance rate could then drop further as there would be no reward obtainable. This view reflects Carnegie Mellon University (2019), where it is claimed that students may lose motivation if their effort is not rewarded. This is a fair criticism but it can be addressed by incorporating a level system so that students can still obtain some recognition for the level of attendance they achieve. For example, 'Gold', 'Silver' and 'Bronze' digital open badges associated with different levels of attendance could be used. The design intention of this approach is that it would offer greater opportunity to obtain a digital open badge for attendance, compared to the all-or-nothing earning mechanism that was used. Such an approach would require careful design and agreement on how the levels are allocated and monitored. For example, there are issues around how legitimate absence could be allowed for, especially where missing a single class would result in a different level being obtained.

Finally, the purpose of this research was to design and evaluate an intervention within the context of a wider issue at the GMIT: retention of first year students. The implication of the findings is that the digital open badges have a positive impact on two factors which play a role in retention, i.e. engagement and motivation. Therefore, it is important that the continued use of digital open badges is considered at a strategic level in the institute. Barriers to wider implementation include scepticism, perceived workload and lack of policy around digital open badges. This thesis will help overcome the barrier of scepticism, given that the benefits of using digital open badges are made clear. Workload can be minimised by focussing on the type of digital open badges shown to have the greatest effect in this thesis, i.e. those for attendance, for levelling-up and for peer learning activities. The final barrier can be addressed through a discourse with stakeholders

at the strategic level, and this thesis will form a reference point for what works, why and how.

6.3 Further research

This study has established the meanings which various stakeholders associate with digital open badges in the unique setting of the CAD module on the Civil Engineering degree at the GMIT. Further, it has demonstrated that the digital open badges play a role in boosting confidence, promoting self-reflection, peer-learning, engagement, motivation, links to employability and attendance.

There are several issues arising from this which are of interest to future research. Firstly, to ascertain the impact of digital open badges on retention, a longer timescale study is required over a number of academic years. This is important as it would test the influence of the novelty factor with the digital open badge scheme and establish empirically the link between the badges and retention.

Secondly, the widening of the digital open badge scheme to other class cohorts in the department is worthy of further study. In particular, research into the impact of digital open badges linked to attendance in other contexts would be useful, as this study has shown that such badges do have an influence on student behaviour, leading to increased interest in attending class on the CAD module.

Thirdly, there is scope to investigate further the peer-learning qualities associated with the digital open badges found in this thesis. Specifically, it would be interesting to see how digital open badges can be incorporated into the practice of peer-assessment, as such practice would mean that all students would have to engage in the process of assessment of the criteria for issuing digital open badges. In this thesis, such engagement was optional and undertaken only by those students who felt their peer deserved recognition, with no impact on assessment grades. From a pedagogical viewpoint, including peer-assessment would facilitate deeper learning.

Fourthly, the self-reflection quality associated with the ‘Level-up’ digital open badges is valued by the stakeholders in this thesis. This has potential for further investigation. For example, in addition to self-reflection relating to seeking skills mastery in particular aspects of assessment (as in this thesis), it would be

interesting if such reflection extended to the scheme itself; what if the students could decide to create and issue their own digital open badges during the module delivery to reflect aspects which they identify as important? This would promote a wider consideration by the students of the module and the digital open badge scheme, their interaction with it, and their interaction with each other. From a teaching and learning perspective, it would be interesting to see the nature and extent of digital open badges created and issued by the students.

Finally, the employer in this thesis recognised the value of the behaviours encouraged by the presence of the digital open badges. This could be expanded to explore the use of digital open badges that are aligned to the expectation of professional accreditation bodies, so that the role of badges as micro-credentials in CPD for engineering graduates can be investigated.

6.4 Reflections on professional practice

I have an engineering background. My undergraduate qualifications are in mining engineering and surveying. My first Masters degree is in sustainable building design. Before becoming a lecturer, I spent eleven years working as an engineer and land surveyor on a variety of construction projects in the UK and Ireland. All of this points to a practical mind. After a career change in 2007 which lead me to lecturing, I nurtured my practical approach to solving problems and applied it to my role as a lecturer. This is an essential skill for graduates of civil engineering to have, and I endeavour to lead by example where possible. I value a student-centred approach to teaching, and I have put much time into thinking about what I can do to make their learning experience the best one possible. I have a keen interest in technology, and so incorporating it into my teaching practice was a natural fit. I focussed on recording video tutorials for software, which later formed the basis for a relatively successful YouTube channel, and which provided the practical element for my second Masters degree (this time in education).

Lower than desirable levels of student retention on the Civil Engineering programme became highlighted during the fallout of the economic recession in Ireland. The institute tasked staff with increasing retention, and I saw an opportunity to combine my interest in technology with the need to engage students, with the aim of retaining them. Retention is a complex issue, with many

variables outside the control of both the institute and the lecturer. However, I discovered the link between motivation and retention, and I felt compelled to try something that might increase motivation. That something was digital open badges. At the time of starting my doctoral journey in 2016, digital open badges had not been used in any formal way at the GMIT. They were just not a ‘thing’ that anyone at the institute had considered using within a module, if at all. I felt that digital open badges were something worth trying out, in the context of exploring avenues that would help motivate students.

In addition to the findings of this research, and the implications that they have for the future implementation of a digital open badge scheme at the GMIT, the process of completing this study has been enlightening for me. In particular, it has shown me that students are very insightful when given the opportunity to contribute. For example, based on previous research in this area I made the assumption that the ‘Level-up’ badges would be seen as a good mechanism for demonstrating skills mastery. In other words, that those digital open badges would be seen as a positive addition to the scheme. It was surprising, and insightful, then, when one student communicated an entirely opposing viewpoint. Where I had envisaged this digital open badge as sending out a positive message about the earner, (i.e. that they are willing to put in extra time and effort to improve their skills), this student viewed the badge as sending out a negative message about the earner (i.e. that the student could not perform under the pressure of a time constraint). His viewpoint provided an interpretation that I simply had not considered previously. This is an example of why involving student participation and not simply taking a top-down approach is important to digital open badge scheme design. What I have learned from this is that assumptions can be challenged and new insights gained by engaging in a discourse with students.

It was my intention to modify the scheme and use it with a second cohort of Year 1 students. The students identified areas where the scheme could be modified (for example, making the digital open badges for attendance more prominent) which remain untested. The reason why this approach could not be used was down to human resource issues at the GMIT. Due to a staff retirement I was required to take on a new module which meant handing the CAD module over to a new staff member. Therefore, I did not have any input or control on that module after the

2017/18 academic year (when the badges were implemented). It was unreasonable to expect the new lecturer to incorporate the digital open badges in addition to the workload involved in starting his new position. Due to this issue, the period where the digital open badges were trialled was one academic year. This has meant that the study could not be repeated to gain confirmatory data. I am confident, however, that the findings are of sufficient strength and interest to inspire continued use of badges at my institute: the benefits of including digital open badges have been demonstrated through this thesis. Given the level of interest from other colleagues (both at the GMIT and elsewhere), developing a policy around the use of digital open badges is a logical next step for the Institute. I feel that the positive findings in this thesis will prove to be the catalyst for this: up until now the expectations around using digital open badges at the Institute were vague.

I have applied the insights gained from this research in the following ways:

- I acted as a consultant for the design of a digital open badge scheme for a Library Association of Ireland online CPD course (March 2017)
- I have given numerous workshops for my colleagues at the GMIT, ranging from 1-hour introductory sessions to a day-long seminar which included a hands-on workshop on digital open badge creation (April 2017, November 2017, November 2018)
- I presented a 1-hour workshop on digital open badges at the RAISE conference in Sheffield Hallam University (September 2018)
- I have presented a 1-hour webinar for teaching, library and support staff at the Dundalk Institute of Technology (April 2019). I was approached to offer guidance and advice on implementing a digital open badge scheme for students at that institute
- I presented a 3-hour workshop on digital open badges for staff at the Athlone Institute of Technology (October 2019). This workshop included an introduction to digital open badges, dissemination of my research findings and a hands-on session with the software used for digital open badges

- I will lead a 1-hour seminar on digital open badges in the GMIT in November 2019, where I have been briefed to discuss the findings of my EdD research in relation to the ‘Level-up’, ‘100% Attendance’ and ‘CAD Buddy’ badges
- I have been asked to showcase the ‘Level-up’ digital open badge as part of a wider set of presentations at a day-long teaching and learning seminar at the GMIT in December 2019
- A new role at the GMIT (Digital Badge Champion) has been created for me. Within this role, I will develop an institute quality assurance policy for digital open badges, and I will be responsible for designing and delivering workshops and clinics for colleagues considering the use of digital open badges in their professional practice.

My research has enabled me to converse with a wider community about digital open badges, and the findings have given me the confidence to present an approach to designing a scheme that has worked. In disseminating my research, I have found that while there is interest in digital open badges in higher education and CPD settings, those interested in using them have little understanding of how and why they can be used. This was particularly evident in one higher education institute where I presented my findings and immediately afterwards I was invited to present there again but for a different audience: institute managers. This indicates that while front-line staff (in that case it consisted of lecturing, library, careers office and work placement staff) are interested in the roles and use of digital open badges in their context, there remains a knowledge gap at management level. What I observed in that case was that the lack of an institute policy around issuing digital open badges has resulted in a perceived absence of quality assurance and a concern that the badges might threaten the traditional credit system in operation there. This view needs to be addressed, and part of that involves educating interested parties in what digital open badges are, why and how they should be used, and the benefits of including them in the learning environment. This thesis will be a reference point for that process.

My research has highlighted the usefulness of digital open badges for confidence boosting, peer-learning, self-reflection, preparedness for CPD and learner

engagement. Based on this research, I am now able to advise others of the potential and manner for using digital open badges in their professional practice.

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Appendices

Appendix 1 – Phase 1 study survey questions

Q1. What year are you currently enrolled on?

- Year 1
- Year 4

Q2. Please indicate how many CAO points you obtained prior to starting the Civil Engineering degree:

- 200-249
- 250-299
- 300-349
- 350-499
- 400-449
- 450 or higher
- N/A, mature applicant

Q3. For each of the following statements, please indicate how true it is for you in relation to activities in the CAD module, using the following scale:

1	2	3	4	5	6	7
not at all true for me				very true for me		

1. I believe that doing this activity could be of some value for me.
2. I believe I had some choice about doing this activity.
3. While I was doing this activity, I was thinking about how much I enjoyed it.
4. I believe that doing this activity is useful for improved concentration.
5. I enjoyed doing this activity very much.
6. I really did not have a choice about doing this activity.
7. I did this activity because I wanted to.
8. I think this is an important activity.
9. I felt like I was enjoying the activity while I was doing it.

10. I thought this was a very boring activity.
11. It is possible that this activity could improve my studying habits.
12. I felt like I had no choice but to do this activity.
13. I thought this was a very interesting activity.
14. I am willing to do this activity again because I think it is somewhat useful.
15. I would describe this activity as very enjoyable.
16. I felt like I had to do this activity.
17. I believe doing this activity could be somewhat beneficial for me.
18. While doing this activity I felt like I had a choice.
19. I felt like it was not my own choice to do this activity.
20. I would be willing to do this activity again because it has some value for me.

Q4. Which of the following social networking sites do you actively use (tick all as appropriate):

- Facebook
- Twitter
- Snapchat
- Instagram
- LinkedIn
- Other: _____
- None of the above

Q5. If you wanted to showcase your performance and achievements in relation to your CAD module, which of the social networks would be your first choice to use (tick one only):

- Facebook
- Twitter
- Snapchat
- Instagram
- LinkedIn
- Other: _____

- None of the above

Q6. Indicate the extent to which you believe each of the following statements is true for you:

Scale 1 (not at all true of me) to 7 (very true of me)

- It is important to me to do better than the other students.
- My goal in this module is to get a better grade than most of the students.
- I am striving to demonstrate my ability relative to others in this module.
- I am motivated by the thought of outperforming my peers in this module.
- It is important to me to do well compared to others in this module.
- I want to do well in this module to show my ability to my family, friends, advisors, or others.
- I want to learn as much as possible from this module.
- It is important for me to understand the content of this course as thoroughly as possible.
- I hope to have gained a broader and deeper knowledge of CAD when I am done with this module.
- I desire to completely master the material presented in this module.
- In a module like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.
- In a module like this, I prefer course material that really challenges me so I can learn new things.
- I often think to myself, "What if I do badly in this module?"
- I worry about the possibility of getting a bad grade in this module.
- My fear of performing poorly in this module is often what motivates me.
- I just want to avoid doing poorly in this module.
- I'm afraid that if I ask my lecturer a "dumb" question, they might not think I'm very smart.
- I wish this module was not graded.

Q7. Do you play any online/console/mobile games?

- Yes {will direct to Q8}
- No {will direct to Q9}

Q8. You said that you play online/console/mobile games. How important is it for you to share your achievements (for example on a high-score leaderboard, or by displaying badges) with others?

- Not important at all
- Somewhat important
- Very important

Q9. Have you ever heard about/seen/received a digital badge in the past?

- Yes
- No

Q10. Digital badges can be used to recognise behaviours and achievements that would not usually be acknowledged in the format of a traditional degree transcript/certificate. If you would like to take part in a focus group to discuss how digital badges might be used in the CAD modules in GMIT, please tick "yes" below. The focus group will take about 1 hour, and there will be refreshments offered to participants.

- Yes
- No

Appendix 2 – Phase 1 Study Student Interview Questions

- When you started first, what was the community like in the class? Did you feel it was easy to fit in, or what was it like when you come in the class first?
- In terms of building a community within the class, do you think there's anything that gmit could do better to help that happen faster?
- In terms of the feedback that you might have had on assessments: what format did that take? If you were to get feedback on the assessment, how would you like to get it?
- And how would you feel about just getting a percentage?
- If you got really good feedback on an assessment would you be inclined to tell your friends and family and share that with people or would you just keep it to yourself?
- Do you think telling other people if you do well as a motivational factor for you?
- Who do you think should design the digital badges scheme? What people should be involved in designing it?
- Do you think that if there was a badge for say, teamwork, the only reason you would do teamwork would be just to get the badge or that some people feel that?
- Can you think of any activities or behaviours in the CAD module so far that you would have liked to have gotten a badge for?
- Do you think it would be better or worse to have the badges available for everybody? What I mean there is how do you feel about having a badge that only one person in the class can get?
- Do you see a role for badges that are available for everybody, not linked to test performance?
- What do you feel about having a leader board in the class so that you can see where you rank with everybody else? Do you think it might demotivate you?
- What would you say is the thing that motivates you the most to come into the CAD module?
- Do you see any advantages in getting a badge?
- Is there anything that you think would make a badge more trustworthy, like if an employer looked at it, would they kind of wonder where is it coming from, or how can you build trust in a badge?

- What do you think about giving a badge yourself to a classmate or a classmate giving you a badge?

Appendix 3 – Phase 1 Study Institute Management Interview Questions

1. What are the typical reasons given for a student withdrawing from a course? What is it that makes them stay if they are considering withdrawal?
2. What can be done to reduce any early-onset anxiety that a student might have after starting in college?
3. What do you think is the biggest motivator for students?
4. How do you think “hidden” learning and/or soft-skills can be captured?
5. Who do you think should be involved in designing a scheme of digital badges?
6. How much of a motivator do you think digital badges would be for students in our department?
7. What advantages do you see in digital badges? What disadvantages?
8. How important do you think it is to recognise finely-grained achievements in addition to an overall grade in a module/programme?
9. Do you think there is any scope to use digital badges as a replacement for grades? Why? What do you think the Institute management would make of this approach?
10. How do you think we can build trust in the badges?
11. Do you think that badges should be available for everyone in the class (e.g. based on attendance where everyone has an opportunity to get a badge), or exclusive for high achievers (e.g. for “best in class” in a topic)?
12. What views do you have on badges that are peer-awarded? How do you think should control the issuing of badges?
13. What activities/behaviours do you think could be recognised with the issue of a digital badge?

Appendix 4– Phase 1 Study Lecturing Staff Interview Questions

- First of all in relation to motivation, what is it that you think makes students stay if they're on the verge of leaving a course?
- is there anything that you think is in our control as Teaching staff that we can do to maybe hang on to them?
- One of the things that is said about digital badges is that they are a good way to capture hidden learning, things that happen that normally may not be picked up by traditional assessments. Do you think that's something that can be captured? how can we capture that type of learning [soft skills]?
- can you see any way that maybe we could build trust in the badges?
- what would you think of students awarding badges to each other?
- in terms of designing the digital Badge Scheme, who do you think should be responsible for saying what the badges are for?
- so you're saying there about involving employers in designing the scheme itself?
- what do you think about the students being involved in designing the scheme?
- do you think the badges might be away for them to get interested if they're involved in actually designing one of their own rewards?
- What do you think is the thing that motivates students the most?
- do you think that badges that are available for everybody are better or worse than they ones where only one person can get it?
- What do you think of having a leaderboard?
- can you think of any advantages for a student getting a digital badge?
- and can you think of any disadvantages to getting one?
- can you think of any behaviour or activity in your module that could be badged?
- if you were going to use on a digital badge scheme in one of your modules, how motivational do you think it would be for your students?

Appendix 5 – Phase 1 Study Employer Interview Questions

- Can you first of all tell me, what are the qualities that you would look for in a graduate from civil engineering?
- Given that you only have certain information on a transcript of grades, where you just see a module name and a grade: how can you tell that that person is going to suit your firm?
- is there any way that you can tell somebody is honest based on their academic qualification?
- if there was a desirable trait we were able to recognise in the class, would it be helpful to you if that was communicated on a transcript in addition to the grades?
- if you saw the badge on an E portfolio or if somebody shows you a website or LinkedIn that said "I've got a badge from GMIT that shows I was a good team player", is that something that you would trust because it had the GMIT brand on it?
- who do you think should be involved in describing what the badge should actually capture?
- if somebody came into you and said "I got a badge from GMIT because my classmates said I was a good leader", would you trust that that was something that was credible or would you refer if it had come from a lecturer?
- do you think there's a role at all for employers getting involved in helping us to identify what should be picked up with a badge?
- is there any scope do you think for maybe a company like yours recognising that, and saying "ok well as a reward for that person we'll bring them into the office for a day and give them a prize of looking at a drawing office for the day" to maybe motivate a student to go for that badge?
- There's a couple of different ways badges can be issued: one that anyone in the class can get and the other type of a badge is the "best in class" where only one person can get it. Do you think one type is better than the other.....from a motivational point of view?

Appendix 6 – Learning journal entries

Student A (Year 1)

Week of the 21st November:

If you did well in the CAD exam, I believe this would merit a badge. Following on from the test we did some work on hatching and different hatching. I didn't see anything there that I thought would merit the need of a badge. I have some reservations about giving badges for simpler things, I think they would become worthless, but also you must find a medium when everyone who tries would receive a badge so they're not only for the person who is smart and does well in the exams. The difficulty there is that it's hard to measure how hard someone is trying and I'm not quite sure how you would do it. For the likes of attending the class each week, I don't think would get a badge, that is something you are expected to do and to award such a simple task would undermine the badge programme, I believe. I think that putting the badges through social media would be a bad idea. Too much focus now is on social media, some people live their lives on it. In my opinion putting the badges on social media would reduce the accomplishment to how many likes you get on the badge on Facebook. I think that something that should be awarded is students helping each other, if you could work out a system of maybe if the student who was helped nominated the helper it could work. I think it will be very hard to work out a balance of what merits a badge and what doesn't.

Week beginning on the 28th of November:

In this week's class, we we're still working on hatching. The drawing we done was quite difficult. Several times I had to ask the lads around me what to do and they also asked me. This type of peer assistance could be something that would deserve a badge. Apart from that assistance I didn't see much else you could give a badge for. I was thinking on it for most of the class and it is quite hard to think on things to give badges for, outside of test results and helping others the opportunities for awarding one would have to come in the moment when you think something is worthy.

Week beginning on the 5th of December:

This week we had the Christmas test. I found it very hard and was pushed for time. I didn't get all the different parts done. Anyone who does well in the exam is well deserving of a badge of some form. We were finished after the test so I didn't find anything else to award a badge for.

Student B (Year 1)

Journal entry 1:

In our morning session, I was having some trouble with modifying the shape we were assigned to do in class. I asked a classmate for help, in which he helped me through the process slowly and clearly until I had a full understanding of how to use the modifying tool. It was a real help as I had to use the same tool that evening during our Assessment 2, so I was very glad he helped me.

I believe people who help others in class, on a good few occasions throughout the year, deserve recognition, and a digital badge which could be viewed by potential employers in the future would go down well in my opinion.

Journal entry 2:

When we arrived in class, we were told our results would more than likely be published the next day (Friday the 25th). This got me thinking of a digital badge for the top grade achieved in the year. Maybe not per assessment but per semester. It would be a great motivator for students, thinking that if you got the best grades out of the whole year, you will receive an award (the badge) in which awards you on your accomplishments. It could be expanded into the different modules, not just in CAD. I believe students would want to work harder, to achieve the best grade they can as a permanent record of being top of your class, something that everyone would be able to see. I think this would be a great idea for the digital badge.

Journal entry 3:

I believe a good idea for a digital badge would be for people who show the greatest improvement throughout the year - not necessarily for the top mark - as it would encourage people to help each other to try and get better at CAD. It would also motivate people who are not getting the best of results to try and improve as recognition would encourage you to work that bit harder.

Student C (Year 4)

[Note: this student added his own disclaimer as shown below]

Please Note: These journal entries are meant for guidance only and are my opinions on the module itself and the expected learning outcomes only. They are not to be construed as an attack or a personal reflection on any of the lecturing personnel in GMIT.

Journal Entry 1 – Civil 3D 21/11/2016

People not arriving in class on time, really brings the group backwards...granted there are exceptions where people get genuinely delayed, but when they have slipped off for a coffee or cigarette between classes and still can't be back on time is annoying. It means the first 15 minutes of the class is wasted getting people up to speed (files downloaded, opened etc.

I can visualise the end goal relatively well in terms of contours, earthworks quantities, road design levels etc. so I am relatively happy in this regard. If you didn't understand the method or rational before you tried it on Civil 3D then I feel you might struggle slightly.

The absence of some guidance notes make it difficult to manoeuvre through commands at times.

I find I am writing quiet a lot in order to give me a step by step through the commands. It can be hard at times to listen to the lecturer, do it on my own machine and also write the commands. A few pages of notes or excerpts from a book relating to that days particular lecture would be great.

I also feel that the absence of works to do outside of class makes it difficult, with just 2 contact hours once a week. Disciplined as I am there are some weeks where I don't get to look at it from class to the next class.

A section of work to have completed for the following week would force you to do this and it would be good. This was the case at the early stages of Robot SA and I found it beneficial. Maybe something that builds up to a submission at the end of term before Christmas and give it few percent or a badge for Continuous Assessment to make it worthwhile. It would also ensure that when students are trying something at home or outside of the class they will come across problems and issues which:

1. They try and problem solve themselves
2. Failing this, e-mail the lecturer for advice or guidance

Both I feel would have positive learning results & outcomes. A digital badge could be awarded for items like this and should accrue towards a very small portion CA at the end of term. Incentivising the class as much as possible would really bring a lot of students on, particularly the ones that are very "grade" driven.

Journal Entry 2 – Revit 22/11/2016

Differs from Civil 3D in that it's easy to envisage the finished project even at early stages. A lot more intricate detail is required when drawing in Revit to produce accurate finished designs.

Learning is simplified with the aid of the manual with the relevant topics for each class.

It's also very beneficial to have the different starting file at the commencement of each class. This way if you have missed the week before or made a mess of the previous weeks drawing, it does not roll over to the next class as you get to start with the new file at the beginning of each lecture.

As with Civil 3D, an extra 2 hours a week would be excellent. Tutorials seem a throwback to the past. I had them when I studied Computers in [institute name] 20 years ago and they were very beneficial. The lecturer (or in some cases Postgraduates/trainees) would go through the works done in the previous practical classes and students could only take notes and ask questions (as they were done in classrooms and away from computer labs)

I find when working on the computers and following the lecturer simultaneously you are not listening intensively, you are more concerned about getting your drawing finished and looking the same without understanding accurately how you got there.

Let's say we had a one hour tutorial today on Revit in which just you were on the computer and the we just watching and took notes it would really enforce what we did yesterday (well in my opinion anyways).

Journal Entry 3 – Robot SA 23/11/2016

Class was dedicated to doing a 2D structure but testing it as a 6 bay 3D structure. This meant there was over 170 wind, snow, dead and imposed load cases applied to the structure. Robot SA is to pick the worst case scenario in terms of beams and columns to test. Was hard to get my head round at times. Watching videos or having a go at doing it outside of the class with some of the others in the class would be good. Probably won't have time for this.

Journal Entry 4 – Civil 3D 28/11/2016

For this class we began looking at putting a building footprint onto a contour site layout drawing and setting a level. This would allow us to calculate the cut fill volume. It was tough to get going at. Supposed to doing this for the integrated project hand up next week but still a long way off it at the moment. Will need YouTube videos if I am to get it done right. Aside from some group discussion with [student name] on areas where we were stuck it's hard to see any potential for the awarding of a badge in today's class.

Journal Entry 5 – Revit 29/11/2016

In class exam. Potential for a badge to be awarded for the completion of the project ahead of time or subsequently for attempting the project at home afterwards and submitting it online for review.

Journal Entry 6 – Robot SA 30/11/2016

Class was dedicated to doing a 3D structure. I found this much easier to do as it was drawn as a 3D structure and you could visualise the effect the load combinations had on it as opposed to last week which was drawn as a 2D structure but tested as a 3D. Meant to do watch some videos of last week's class but didn't and subsequently would not be able to complete last week's work again if I sat down to do it now. This class was also aimed as a trial run for the exam next week.

Journal Entry 7 – Civil 3D 05/12/2016

This class was dedicated to having another go at putting a building foundation onto a map of contours and determining the cut and fill volume. There was a section of the integrated project due on Friday last which needed to have this cut/fill information in it. I had spent a number of hours the previous week watching online tutorial videos on YouTube so when it came to doing it in class I was very familiar with it. I should get recognition for same. I also spent some time going through what I had learnt with [student name] who is doing the project with me. This should be recognised by the institute and subsequently reward me for same.

Journal Entry 8 – IESVE 06/12/2016

Commenced looking at IESVE software package. New to me and probably most people in the class. Not as user friendly as AutoCAD products to use. Seems very interesting from what we were shown in terms of increasing window sizes to achieve the amount of natural light getting into a room. Seems to be one of those packages (like Robot SA) where there is a certain amount of trial and error and re-running the program to get the desired results. The potential is there to look into it further over the holidays with a view to understanding it more and being ahead when it starts up again in January. Additional learning outside of the class time should be rewarded with a digital badge in this case.

Journal Entry 9 – Robot SA 07/12/2016

In class exam. I had worked on the previous week's example over the weekend and also with [student name] in a group setting to brain storm ideas and identify potential pitfalls that may arise during the exam. I tried to complete the exam paper again in the afternoon after the exam to see how close I was to completing it during the test. Should be allowed to submit this to the lecturer for review and possibly earn a badge for same. All too often I would have thrown the exam paper aside after the exam and never worked again.

Appendix 7 – Phase 2 Pre-delivery survey questions

Q1. Please enter your Student Identification Number:

Q2. Please indicate how many CAO points you obtained prior to starting the Civil Engineering degree:

- 200-249
- 250-299
- 300-349
- 350-399
- 400-449
- 450 or higher
- N/A, mature applicant

Q3. For each of the following statements, please indicate how true it is for you in relation to your thoughts about the CAD module, using the following scale:

1	2	3	4	5	6	7
not at all true for me				very true for me		

1. I believe that doing this module could be of some value for me.
2. I believe I had some choice about doing this module.
3. I think I will enjoy doing this module.
4. I believe that doing this module is useful for improving concentration.
5. I expect that this module will be enjoyable.
6. I really did not have a choice about doing this module.
7. I am doing this module because I wanted to.
8. I think this is an important module.
9. I feel like I will enjoy the module while I am doing it.
10. I think this will be a very boring module.
11. It is possible that this module could improve my studying habits.
12. I feel like I had no choice but to do this module.

13. I think this will be a very interesting module.
14. I am willing to do this module because I think it is somewhat useful.
15. I would describe this module as very enjoyable.
16. I feel like I have to do this module.
17. I believe doing this module could be somewhat beneficial for me.
18. While doing this module I feel like I have a choice.
19. I feels like it was not my own choice to do this module.
20. I am willing to do this module because it has some value for me.

Q4. Which of the following social networking sites do you actively use (tick all as appropriate):

Options are Never, Sometimes, Often

- Facebook
- Twitter
- Snapchat
- Instagram
- LinkedIn

Q5. Indicate the extent to which you believe each of the following statements is true for you:

Scale 1 (not at all true of me) to 7 (very true of me)

- It is important to me to do better than the other students.
- My goal in this module is to get a better grade than most of the students.
- I am striving to demonstrate my ability relative to others in this module.
- I am motivated by the thought of outperforming my peers in this module.
- It is important to me to do well compared to others in this module.
- I want to do well in this module to show my ability to my family, friends, advisors, or others.
- I want to learn as much as possible from this module.

- It is important for me to understand the content of this course as thoroughly as possible.
- I hope to have gained a broader and deeper knowledge of CAD when I am done with this module.
- I desire to completely master the material presented in this module.
- In a module like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.
- In a module like this, I prefer course material that really challenges me so I can learn new things.
- I often think to myself, "What if I do badly in this module?"
- I worry about the possibility of getting a bad grade in this module.
- My fear of performing poorly in this module is often what motivates me.
- I just want to avoid doing poorly in this module.
- I'm afraid that if I ask my lecturer a "dumb" question, they might not think I'm very smart.
- I wish this module was not graded.

Q6. How often do you play games on the following platforms?

Options are Never, Sometimes, Often

- Smartphone
- Tablet
- Computer
- Console

Q7: In relation to playing online/console/mobile games, please indicate your level of agreement with the following statements.

Options are Agree, Somewhat agree, Neither agree nor disagree, Disagree, Not applicable

- Monitoring my performance on a leader board is important to me
- It is motivating to receive in-game achievements or trophies
- I compare my progress to other players

- I compare my performance scores to other players
- I am not interested in how well other players are doing
- I like single player games
- Maintaining a position I've earned is important to me
- I talk to about or share my achievements with others
- It is important that I can see my progress as I play
- Earning upgrades and power-ups is important to me
- Moving up levels gives me a sense of progress

Q8: Having watched the video introduction to digital badges, please indicate your response to the following statements:

Options are Agree, Disagree, Don't know

- This is the first time I have heard about digital badges
- I have received digital badges previously
- I would like to earn some digital badges
- I think digital badges would enhance my experience of the CAD module
- I would like to be able issue digital badges to my classmates
- I would like my classmates to issue digital badges to me
- I think digital badges should only be given to the best student in the class
- I think anyone that completes a task to certain level of proficiency (even if they are not the best in class) should get a digital badge
- Digital badges should be available for more than just assessment feedback
- I have some ideas for what a digital badge should be given for (please add comment below to explain)

Appendix 8 – Phase 2 Post-delivery survey questions

Q1. Please enter your Student Identification number:

Q2. For each of the following statements, please indicate how true it is for you in relation to your thoughts about the CAD module, using the following scale:

1 2 3 4 5 6 7

not at all true for me very true for me

1. I believe that doing this module has been of some value for me.
2. I believe I had some choice about doing this module.
3. I enjoyed doing this module.
4. I believe that doing this module is useful for improving concentration.
5. I expected that this module would be enjoyable.
6. I really did not have a choice about doing this module.
7. I did this module because I wanted to.
8. I think this is an important module.
9. I feel like I enjoyed the module while I was doing it.
10. I think this will was a very boring module.
11. It is possible that this module could improve my studying habits.
12. I feel like I had no choice but to do this module.
13. I think this was a very interesting module.
14. I was willing to do this module because I think it is somewhat useful.
15. I would describe this module as very enjoyable.
16. I feel like I had to do this module.
17. I believe doing this module has been somewhat beneficial for me.
18. While doing this module I felt like I have a choice.
19. I felt like it was not my own choice to do this module.
20. I was willing to do this module because it has some value for me.

Q3. Indicate the extent to which you believe each of the following statements is true for you:

Scale 1 (not at all true of me) to 7 (very true of me)

- It is important to me to do better than the other students.
- My goal in this module is to get a better grade than most of the students.
- I am striving to demonstrate my ability relative to others in this module.
- I am motivated by the thought of outperforming my peers in this module.
- It is important to me to do well compared to others in this module.
- I want to do well in this module to show my ability to my family, friends, advisors, or others.
- I want to learn as much as possible from this module.
- It is important for me to understand the content of this course as thoroughly as possible.
- I hope to have gained a broader and deeper knowledge of CAD when I am done with this module.
- I desire to completely master the material presented in this module.
- In a module like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.
- In a module like this, I prefer course material that really challenges me so I can learn new things.
- I often think to myself, "What if I do badly in this module?"
- I worry about the possibility of getting a bad grade in this module.
- My fear of performing poorly in this module is often what motivates me.
- I just want to avoid doing poorly in this module.
- I'm afraid that if I ask my lecturer a "dumb" question, they might not think I'm very smart.
- I wish this module was not graded.

Q4. Having experienced how digital badges are incorporated in the CAD module, please indicate your response to the following statements:

(Response options will be Agree, Disagree, Don't Know)

- I liked to earn digital badges
- I think digital badges enhanced my experience of the CAD module
- I liked being able to nominate a classmate for a digital badge
- I think that only the lecturer should issue digital badges
- I think digital badges should only be given to the best student in the class
- I would like my classmates to issue digital badges to me
- I think digital badges should only be given to the best student in the class
- I think anyone that completes a task to certain level of proficiency (even if they are not the best in class) should get a digital badge
- Digital badges should be available for more than just assessment feedback
- I discussed the badges with my classmates
- There were too few badges offered on the module
- The badges were aesthetically pleasing
- I displayed my badges on my social media/networks
- I liked knowing how to earn badges in advance
- I liked finding out about the mystery badges as a surprise
- I would have preferred to know about how to earn all the badges in advance
- I think badges should be available in other modules
- I would choose a course that offers badges over one that does not
- Badges linked to assessments are more valuable than badges linked to non-academic things like attendance and being a helpful classmate
- I obtained all the badges that I set out to earn
- Overall, the digital badges increased my motivation on the CAD module

The following questions require a short typed answer. Please answer honestly.

Q5. Please state which was your most favourite badge (even if it is one you did not earn yourself):

Q6. Please state which was your least favourite badge (even if it is one you did not earn yourself):

Q7. If there was a badge that you really wanted to get, but didn't, which one was it?

Q8. If you have any ideas for what a digital badge should be given for, please state these here:

Q9. Invitation to interview stage (yes/no)

Appendix 9 – Phase 2 study student interview questions

1. What particular type of badge do you have a preference for? Why?
2. Would you want to earn any of these badges and why?
3. Was there a badge that you really wanted to get, but didn't? Which ones?
Follow up: Were there any badges that you were not interested in? Why?
4. Did you claim all of the badges that you were eligible for? Why/why not?
Follow up: Were there any badge that you really wanted to get, but didn't? Which ones? Why?
5. Did the badges motivate you in our studies?
6. How involved in the digital badge process did you feel? You had the opportunity to issue a badge through peer nomination, and an opportunity to suggest ideas for badges in the survey, so can you expand on your thoughts about this?
7. Would you like to see badges in other modules in Year 1, and/or carried through the CAD module into Year 2? If so, for what reason? This can be in general, or along the same lines as those already used.
8. What activities, behaviours or accomplishments would you like to see badges awarded for? Why do/do not the present set meet these?
9. Did you share any of the digital badges you earned? Why/why not? Where?
10. Did you like the way in which the Mystery Badges were run? Follow ups: Did the transparency/lack thereof influence engagement with the badge award scheme? If you had known the mechanism for earning in advance, would it have affected your behaviour? Why/why not?

Appendix 10 – Validation of instruments used to measure motivation

In both the Phase 1 and Phase 2 stages of the research, two instruments were used in student surveys to measure motivation type and level (see Section 3.4.2 and 3.4.4). Motivation type (intrinsic/extrinsic) was measured using the Achievement Goal Theory questions and motivation level was measured using the Self-Determination Theory questions. The use of these instruments has precedent in research into motivation, as identified in the review of literature in this field (for example McCord and Matusovich, 2013). The achievement goal theory questions used are based on those found in Elliot and Church (1997). In their study, a set of 18 questions was presented in 3 categories: performance-approach goal, skills mastery and performance-avoidance goal. The contention in Elliot and Church (1997) is that higher mean responses in the skills mastery category can be said to indicate higher tendency towards intrinsic motivation. In their study, Elliot and Church (1997) used factor analysis on a sample size of 204 to show the factor loadings on the 3 categories.

In the Phase 1 stage (autumn 2016), 45 Year 1 students completed the online survey. At the Phase 2 stage (autumn 2017), 49 Year 1 students completed the online survey. Although these are two cohorts, they are similar to each other, considering they are engineering students engaged in the same CAD module on the same programme at the same institute. The surveys undertaken by these students contained the same questions relating to achievement goal theory and self-determination theory. The responses were combined to give a sample size of 94 students, which was then used for a factor analysis to ascertain if the same loadings apply in this case.

According to Bryant and Yarnold (1995), the sample size should be five times the number of variables, with a minimum of 100. This criterion is not met in this case, although 94 is close to 100 and was limited by the class size available in the study.

Table A10.1, below, shows the factor loadings for the achievement goal theory (AGT) questions.

Table A10.1 Achievement goal items and their primary and secondary loading factors

AGT Survey Question	Category	Factor loadings		
		1	2	3
1	Performance- Approach Goal	.857	(-.121)	
2		.861		(.070)
3		.834	(.092)	
4		.798		(.028)
5		.781		(.141)
6		.423	(.130)	
7	Skills Mastery	(.127)	.712	
8			.732	(.113)
9			.591	(-.104)
10		(.325)	.595	
11		.328	(.217)	
12		.578	(.219)	
13	Performance- Avoidance Goal	(-.051)		.892
14		(.114)		.835
15			(.271)	.608
16		(-.087)		.592
17			(-.287)	.486
18			(-.328)	.451

Note: N= 94. Primary factor loadings are in bold; secondary factor loadings are in brackets

Factor 1 is 24.2% of variance (eigenvalue 4.35) (33.1% and 5.95 in E&C)

Factor 2 is 15.5% of variance (eigenvalue 2.84) (18.2% and 3.27 in E&C)

Factor 3 is 11.3% of variance (eigenvalue 2.03) (12% and 2.16 in E&C)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.648
Bartlett's Test of Sphericity	Approx. Chi-Square	729.885
	df	153
	Sig.	.000

Varimax rotation was used.

Table A10.2, below, shows the factor loadings for the same questions in the Elliot and Church (1997) study.

Table A10.2 Achievement goal items and their primary and secondary loading factors from Elliot and Church (1997, p.223)

Achievement Goal Items and Their Primary and Secondary Factor Loadings

Achievement goal item	Factor		
	1 Performance- Approach Goal	2 Mastery Goal	3 Performance- Avoidance Goal
It is important to me to do better than the other students.	.90		[.03]
My goal in this class is to get a better grade than most of the students.	.88		[.10]
I am striving to demonstrate my ability relative to others in this class.	.83	[.26]	
I am motivated by the thought of outperforming my peers in this class.	.82		[.29]
It is important to me to do well compared to others in this class.	.81	[.19]	
I want to do well in this class to show my ability to my family, friends, advisors, or others.	.62		[.32]
I want to learn as much as possible from this class.		.86	[.12]
It is important for me to understand the content of this course as thoroughly as possible.	[.07]	.84	
I hope to have gained a broader and deeper knowledge of psychology when I am done with this class.	[.08]	.82	
I desire to completely master the material presented in this class.	[.28]	.80	
In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	[-.01]	.73	
In a class like this, I prefer course material that really challenges me so I can learn new things.	[.18]	.71	
I often think to myself, "What if I do badly in this class?"	[.27]		.82
I worry about the possibility of getting a bad grade in this class.	[.18]		.80
My fear of performing poorly in this class is often what motivates me.	[.22]		.71
I just want to avoid doing poorly in this class.		[.10]	.64
I'm afraid that if I ask my TA or instructor a "dumb" question, they might not think I'm very smart.	[.21]		.58
I wish this class was not graded.		[-.19]	.44

Note. $N = 204$. Primary factor loadings are in bold; secondary factor loadings are in brackets. TA = teaching assistant.

The factor loadings in the Phase 1 and Phase 2 survey responses are similar to those found in Elliot and Church (1997). A Cronbach's α test was carried out on

the three categories (performance approach, skills mastery and performance-avoidance approach), which returned acceptable to good levels of consistency ($\alpha = .874, .621$ and $.741$ respectively). This provides support for the categories used validates the use of that set of questions in this case. Differences may be accounted for by the difference in sample size between the two studies; the class size in this case was a limiting factor. The only two questions where the primary factor loadings are not in alignment with the findings of Elliot and Church (1997) relate to the module being challenging and difficult to learn. In this case, the primary loading is in the performance-approach goal rather than the skills mastery goal. This suggests that the students are concerned that the challenging nature of the module may result in poorer results compared to their peers.

The survey questions relating to self-determination theory are based on the ‘intrinsic motivation index’(IMI) developed by Deci and Ryan (1985). Similar to the questions based on the Elliot and Church (1997) study, the questions based on the intrinsic motivation index fall into three categories: value/usefulness, perceived choice and interest/enjoyment. Using the sample of 94 students, a factor analysis was carried out on the responses to ascertain if the loadings indicate these three categories. Table A10.3, below, shows the factor loadings identified.

Table A10.3 Intrinsic motivation index items and their primary and secondary loading factors

IMI Survey Question	Category	Factor Loadings		
		1	2	3
1	Value/usefulness	(.395)		.477
4		.600	(.175)	
8		(.153)		.698
11		.412		(.198)
14		(.260)		.711
17		(.218)		.680
20		(.181)		.762
2	Perceived choice	(-.205)	.809	
6			.853	(-.089)
7		(.327)	.540	
12		(.096)	.840	
16			.661	(-.168)
18			.701	(-.056)

19			.623	(-.042)
3	Interest/enjoyment	.633	(-.168)	
5		.819		(.226)
9		.804		(.320)
10		.669	(.210)	
13		.619		(.282)
15		.768		(.345)

Note: N= 94. Primary factor loadings are in bold; secondary factor loadings are in brackets

Factor 1 is 27.2% of variance (eigenvalue 5.44)

Factor 2 is 19.8% of variance (eigenvalue 3.95)

Factor 3 is 7.01% of variance (eigenvalue 1.40)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.814
Bartlett's Test of Sphericity	Approx. Chi-Square	837.572
	df	190
	Sig.	.000

Varimax rotation was used.

There is an indication that the three factors are present for the student participants in this study. A Cronbach's α test was carried out on the three categories (value/usefulness, perceived choice and interest/enjoyment), which returned good levels of consistency ($\alpha = .713, .852$ and $.855$ respectively). Only two of the twenty questions fall outside of the expected category. The first (question 4) relates to the students' expectation that the module could be useful for improving concentration, and the second (question 11) relates to their expectation that the module could improve their studying habits. In both cases, the primary factor loading is on the 'interest/enjoyment' category rather than the expected 'value/usefulness' category. This suggests that the students' concentration levels and studying habits are driven more by their enjoyment and interest in the module rather than by a perceived usefulness.

Given that the factor analysis loadings are similar to previous research into motivation, and internal reliability is acceptable to good, the two instruments used to investigate motivation are considered appropriate and suitable in this case.

Appendix 11 – Details of digital open badges used



CAD ASSESSMENT 1 HIGH ACHIEVER

This badge is awarded for excellent performance in the first assessment on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

The assessment was a timed test to measure the following skills in AutoCAD:

- correct selection of drawing template
- correct drawing management
- use of absolute, relative, polar and tracking co-ordinates
- ability to draw basic shapes (lines, arcs)
- ability to draw and edit polylines
- ability to correctly select appropriate layer

The earner of this badge demonstrated that they could apply the above skills to draw a number of shapes to a standard of 80% or higher in the test.



CAD ASSESSMENT 2 HIGH ACHIEVER

This badge is awarded for excellent performance in the second assessment on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

The assessment was a timed test to measure the following skills in AutoCAD:

- correct selection of drawing template
- correct drawing management
- ability to correctly select appropriate layer
- use of absolute, relative, polar and tracking co-ordinates
- ability to draw more advanced shapes
- use of "modify" commands to increase drawing efficiency
- use of dimensions and leaders

The earner of this badge demonstrated that they could apply the above skills to draw a number of shapes to a standard of 80% or higher in the test.



CAD WINTER TEST HIGH ACHIEVER

This badge is awarded for excellent performance in the Winter Test on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

The Winter Test is the first significant milestone assessment on the CAD module. It is a 2-hour test which contributes 20% to the marks for the module. Excellent performance in this test is a good indicator of progress and potential for passing the module overall.

The test requires the student to complete two drawings in CAD. The first is a cross section through a reinforced and tanked basement detail. The second is a geometric shape that assesses the ability to use linetypes and various modifying tools.

The tasks involved the following:

- correct selection of drawing template
- correct drawing management
- ability to correctly select appropriate layers
- use of relative, polar and tracking co-ordinates
- ability to draw various linetypes
- use of "modify" commands to increase drawing efficiency
- use of dimensions and leaders
- interpretation of drawing to extract information required
- correct use of hatching

The earner of this badge demonstrated that they could apply the above skills to complete the assessment to a standard of 80% or higher.



EXCEL EXPLORER

This badge is issued for demonstrating an excellent practical knowledge of the basic functions and operations of MicroSoft Excel within the CAD module of Civil Engineering Year 1.

#CAD, #WG

The recipient of this badge has demonstrated an excellent understanding of the basics of MicroSoft Excel. Excel training is a component of the Civil Engineering Year 1 "Computer Aided Design" module, and the skills covered include cell basics, formatting cells, simple and complex formulas, tables, sorting, filtering, conditional formatting and charts. These skills are assessed via a multiple choice quiz, and the recipient of this badge scored 100% in that test.



CAD PROJECT HIGH ACHIEVER

This badge is awarded to the student with a high achiever performance in the End of Year Project on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

The End of Year Project is a capstone assessment on the CAD module. It is a significant piece of work which contributes 30% to the marks for the module. Excellent performance in this Project is a good indicator of understanding of the main drawing commands and conventions.

The Project requires the student to complete a full set of plans, elevations and a cross-section for a dwelling house in CAD. The aim of the Project is to produce a drawing that meets the relevant Irish Building Regulations, using acceptable building details, and to a standard that has buildability and planning permission in mind.

The tasks involved in the Project include:

- correct selection of drawing template
- correct drawing management
- ability to correctly select appropriate layers
- use of relative, polar and tracking co-ordinates
- ability to draw various linetypes
- use of "modify" commands to increase drawing efficiency
- use of annotative text, dimensions and leaders
- interpretation of drawing to extract information required
- correct use of hatching
- viewport control for scaling
- insertion of title block with attributes
- neat and tidy layout of page
- selection and application of ctb file
- plotting to scale
- working on own time and initiative to meet a deadline

The earner of this badge completed the Project to a standard achieving a grade of 80% or above.



CAD IMPROVER 1

This badge is awarded for demonstrating progress between the first and second assessments on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

It is important to recognise when a student shows progression in their own development. The first two assessments in the CAD module require a student to apply skills to complete tasks within a time limit.

The CAD skills used in these two assessments include:

- correct selection of drawing template
- correct drawing management
- use of absolute, relative, polar and tracking co-ordinates
- ability to draw basic shapes (lines, arcs)
- ability to draw and edit polylines
- ability to correctly select appropriate layer
- ability to draw more advanced shapes
- use of "modify" commands to increase drawing efficiency
- use of dimensions and leaders

To earn this badge, the student has demonstrated an increasing level of knowledge and application of the skills needed to work on AutoCAD software.



CAD IMPROVER 2

This badge is awarded for demonstrating progress between the second and third assessments on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

It is important to recognise when a student shows progression in their own development. The second and third assessments in the CAD module require a student to apply skills to complete tasks within a time limit.

The CAD skills used in these two assessments include:

- correct selection of drawing template
- correct drawing management
- ability to correctly select appropriate layers
- use of relative, polar and tracking co-ordinates
- ability to draw various linetypes
- use of "modify" commands to increase drawing efficiency
- use of dimensions and leaders
- interpretation of drawing to extract information required
- correct use of hatching

To earn this badge, the student has demonstrated an increasing level of knowledge and application of the skills needed to work on AutoCAD software.



LEVEL UP 1

This badge is awarded for engaging with skills mastery in the first assessment on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

To earn this badge, the recipient undertook extra work to improve on their performance in the first assessment in the CAD module. The extra work took the form of a second attempt at the assessment test, which measured the following aspects:

- correct selection of drawing template
- correct drawing management
- use of absolute, relative, polar and tracking co-ordinates
- ability to draw basic shapes (lines, arcs)
- ability to draw and edit polylines
- ability to correctly select appropriate layer

No change in grade is associated with this badge (the student's first attempt is the official grade awarded as it was obtained in an exam situation). However, the earner of this badge has shown that they are motivated to improve their CAD skills even where grade reward is not available.



LEVEL UP 2

This badge is awarded for engaging with skills mastery in the second assessment on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

To earn this badge, the recipient undertook extra work to improve on their performance in the second assessment in the CAD module. The extra work took the form of a second attempt at the assessment test, which measured the following aspects:

- correct selection of drawing template
- correct drawing management
- ability to correctly select appropriate layer
- use of absolute, relative, polar and tracking co-ordinates
- ability to draw more advanced shapes
- use of "modify" commands to increase drawing efficiency
- use of dimensions and leaders

No change in grade is associated with this badge (the student's first attempt is the official grade awarded as it was obtained in an exam situation). However, the earner of this badge has shown that they are motivated to improve their CAD skills even where grade reward is not available.



LEVEL UP 3

This badge is awarded for engaging with skills mastery in the Winter Test assessment on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

To earn this badge, the recipient undertook extra work to improve on their performance in the Winter Test in the CAD module. The extra work took the form of a second attempt at the assessment test.

The test requires the student to complete two drawings in CAD. The first is a cross section through a reinforced and tanked basement detail. The second is a geometric shape that assesses the ability to use linetypes and various modifying tools.

The tasks involved the following:

- correct selection of drawing template
- correct drawing management
- ability to correctly select appropriate layers
- use of relative, polar and tracking co-ordinates
- ability to draw various linetypes
- use of "modify" commands to increase drawing efficiency
- use of dimensions and leaders
- interpretation of drawing to extract information required
- correct use of hatching

No change in grade is associated with this badge (the student's first attempt is the official grade awarded as it was obtained in an exam situation). However, the earner of this badge has shown that they are motivated to improve their CAD skills even where grade reward is not available.



BEST IN CLASS, CAD WINTER TEST

This badge is awarded to the student with the best performance in the Winter Test on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

The Winter Test is the first significant milestone assessment on the CAD module. It is a 2-hour test which contributes 20% to the marks for the module. Excellent performance in this test is a good indicator of progress and potential for passing the module overall.

The test requires the student to complete two drawings in CAD. The first is a cross section through a reinforced and tanked basement detail. The second is a geometric shape that assesses the ability to use linetypes and various modifying tools.

The tasks involved the following:

- correct selection of drawing template
- correct drawing management
- ability to correctly select appropriate layers
- use of relative, polar and tracking co-ordinates
- ability to draw various linetypes
- use of "modify" commands to increase drawing efficiency
- use of dimensions and leaders
- interpretation of drawing to extract information required
- correct use of hatching

The earner of this badge completed the test to the highest standard in the class.



BEST CAD PROJECT IN CLASS

This badge is awarded to the student with the best performance in the End of Year Project on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

The End of Year Project is a capstone assessment on the CAD module. It is a significant piece of work which contributes 30% to the marks for the module. Excellent performance in this Project is a good indicator of understanding of the main drawing commands and conventions.

The Project requires the student to complete a full set of plans, elevations and a cross-section for a dwelling house in CAD. The aim of the Project is to produce a drawing that meets the relevant Irish Building Regulations, using acceptable building details, and to a standard that has buildability and planning permission in mind.

The tasks involved in the Project include:

- correct selection of drawing template
- correct drawing management
- ability to correctly select appropriate layers
- use of relative, polar and tracking co-ordinates
- ability to draw various linetypes
- use of "modify" commands to increase drawing efficiency
- use of annotative text, dimensions and leaders
- interpretation of drawing to extract information required
- correct use of hatching
- viewport control for scaling
- insertion of title block with attributes
- neat and tidy layout of page
- selection and application of ctb file
- plotting to scale
- working on own time and initiative to meet a deadline

The earner of this badge completed the Project to the highest standard in the class.



GMIT AND RPS BEST MENTOR IN CLASS

This digital open badge has been developed in a collaboration between Galway-Mayo Institute of Technology and RPS (Galway). This badge recognises a combination of good interpersonal skills and technical skills, two traits desirable in the engineering profession. This badge is awarded to one student per year on the Computer Aided Design module in Year 1 of the Degree in Civil Engineering at the Galway-Mayo Institute of Technology.

The recipient of this badge has demonstrated that they have engaged with the learning material for CAD module in Year 1 of the BEng in Civil Engineering degree at the Galway-Mayo Institute of Technology. The learning outcomes for this module are such that on successful completion of the module, a learner should be able to:

- Recognise practical skills in the area of Computer Aided Drawing
- Represent graphically the development and refinement of problem solving ideas
- Illustrate ideas and solutions to problems, using acceptable drawing conventions, symbols and standards for presentation
- Demonstrate ideas and solutions in a clear, unambiguous manner
- Identify the commands associated with the efficient production of drawings for construction
- Apply the knowledge of drawing conventions
- Interpret and understand what is represented graphically and extract what information is needed from a drawing

To earn this badge, the recipient had to meet two criteria:

1. They had to have been nominated by their peers as a helpful classmate
2. They had to achieve the highest overall final grade of all the students nominated as helpful

Nominations for being helpful were gathered in a formal (written) manner, where the nominator provided a description of the helpful event. A number of students were nominated in such a manner, and their efforts are recognised by the "CAD Buddy" digital badge. The highest overall grade was determined based upon summing the academic performance across all of the assessments throughout the year on the module.



100% ATTENDANCE SEMESTER 1

This badge is awarded for 100% attendance at the Computer Aided Design module in Year 1 of the Civil Engineering degree at the Galway-Mayo Institute of Technology.

In most cases there is a close correlation between attendance at a module and subsequently passing that module.

Over the first Semester (13 weeks), students will have received a maximum of 39 hours of tutorials, lectures and training on how to use AutoCAD. To maximise learning, a good attendance is essential.

To earn this badge, the student has attended 100% of the classes for CAD in Semester 1. This demonstrates a good level of discipline and commitment, both of which are desirable traits not only in student-life, but in the broader community of practice as well.



100% ATTENDANCE SEMESTER 2

This badge is awarded for 100% attendance in Semester 2 at the Computer Aided Design module in Year 1 of the Civil Engineering degree at the Galway-Mayo Institute of Technology.

#cad

In most cases there is a close correlation between attendance at a module and subsequently passing that module.

Over the second Semester (13 weeks), students will have received a maximum of 39 hours of tutorials, lectures and training on how to use AutoCAD. To maximise learning, a good attendance is essential.

To earn this badge, the student has attended 100% of the classes for CAD in Semester 2. This demonstrates a good level of discipline and commitment, both of which are desirable traits not only in student-life, but in the broader community of practice as well.



100% ATTENDANCE ALL YEAR

This badge is awarded for 100% attendance over the whole academic year in the Computer Aided Design module in Year 1 of the Civil Engineering degree at the Galway-Mayo Institute of Technology.

#cad

In most cases there is a close correlation between attendance at a module and subsequently passing that module.

Over the full academic year, students will have received a maximum of 78 hours class contact time (tutorials, lectures) and training on how to use AutoCAD. To maximise learning, a good attendance is essential. In addition, self-directed and peer learning will have taken place outside of class contact hours.

To earn this badge, the student has attended 100% of the classes for CAD over the entire academic year. This demonstrates an excellent level of discipline and commitment, both of which are desirable traits not only in student-life, but in the broader community of practice as well.



CAD BUDDY (BRONZE)

This badge is part of the suite of digital open badges available as part of the Computer Aided Design module on the BEng in Civil Engineering at the Galway-Mayo Institute of Technology, Galway, Ireland.

This badge is awarded to a student that has been nominated by a classmate for it.

Peer-learning, collaboration and communication skills are essential skills for a student to practice. As an example of this, when a student helps a classmate to solve a problem, they are putting into practice these valuable skills. However, it can be difficult to adequately acknowledge when such interactions occur.

This digital open badge can be understood as a means of recognising and rewarding when peer-learning, collaboration and communication skills are used.

This "Bronze" level badge is an entry-level badge, and further (Silver and Gold) versions are awarded for repeated and prolonged demonstration of peer-learning, collaboration and communication skills.

The earner of this badge has demonstrated that they are capable and willing to offer help and guidance to a classmate on the Computer Aided Design module.

Every student on the module has the opportunity to earn this badge.

When a student has received help (this can be both in-class and/or at any point in time), they have the opportunity to nominate the person that helped them. As part of the nomination, they provide their own name, the name of the person they are nominating, the date of the event and a brief description of how the nominee was helpful. This nomination application is then reviewed by the lecturer, and the badge is released if the nomination is deemed accurate and valid.

The Bronze level CAD Buddy badge is an entry-level award, and further (Silver and Gold) versions are awarded for repeated and prolonged demonstration of peer-learning, collaboration and communication skills.

To earn the Bronze badge, the student had to be nominated on one occasion.